ACTA·COLL·MED·PHILAD·INSTIT·A·D·MDCCLXXXVII

NON SIBI SED TOTI

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College of Physicians of Philadelphia

19 S. 22d St., Philadelphia, U. S. A.

TRANSACTIONS

OF THE

COLLEGE OF PHYSICIANS

OF

PHILADELPHIA

THIRD SERIES

VOLUME THE FORTY-THIRD

ACTA·COLL·MED·PHILAD·INSTIT·A·D·MDCCLXXXVII·

NON SIBI SED TOTI

PHILADELPHIA
PRINTED FOR THE COLLEGE
1921

NOTICE

The present volume of TRANSACTIONS contains the papers read before the College from January, 1921, to December, 1921, inclusive.

The Committee of Publication thinks it proper to say that the College holds itself in no way responsible for the statements, reasonings, or opinions set forth in the various papers published in its TRANSACTIONS.

EDITED BY

WALTER G. ELMER, M.D.

"This volume is published in part by the income from the Francis Houston Wyeth Fund."

DORNAN, PRINTER

CONTENTS

APPENDIX

LIST

OF THE

PRESIDENTS OF THE COLLEGE FROM THE TIME OF ITS INSTITUTION

ELECTED	
1787	JOHN REDMAN
1805	WILLIAM SHIPPEN
1809	ADAM KUHN
1818	THOMAS PARKE
1835	THOMAS C. JAMES[1]
1835	THOMAS T. HEWSON
1848	GEORGE B. WOOD
1879	W. S. W. RUSCHENBERGER
1883	ALFRED STILLÉ
1884	SAMUEL LEWIS[2]
1884	J. M. DA COSTA
1886	S. WEIR MITCHELL
1889	D. HAYES AGNEW
1892	S. WEIR MITCHELL
1895	J. M. DA COSTA
1898	JOHN ASHHURST, JR.
1900	W. W. KEEN
1902	HORATIO C WOOD
1904	ARTHUR V. MEIGS
1907	JAMES TYSON
1910	GEORGE E. DE SCHWEINITZ
1913	JAMES CORNELIUS WILSON
1916	RICHARD H. HARTE
1919	WILLIAM J. TAYLOR

[1] Died four months after his election.
[2] Resigned on account of ill-health.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

1921

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(until February, 1923)

Richard H. Harte, M.D.

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(until February, 1924)

Francis R. Packard, M.D., *Ch'n*
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Clerk, Nathan P. Stauffer, M.D.

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Clerk, E. J. G. Beardsley, M.D.

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Clerk, H. R. M. Landis, M.D.

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Clerk, William S. Higbee, M.D.

FELLOWS

OF THE

COLLEGE OF PHYSICIANS OF PHILADELPHIA

DECEMBER, 1921

* Non-resident Fellows.
† Fellows who have commuted dues.

ELECTED

1892. ABBOTT, CHARLES CREVER, M.D., Sc. D., Dr. P.H., Professor
1921. of Hygiene and Bacteriology and Director of the School of Hygiene and Public Health; University of Pennsylvania. 4016 Pine St.

1912. ADDISON, WILLIAM H. F., A.B., M.D., Professor of Normal Histology and Embryology in the University of Pennsylvania. Medical Laboratories, University of Pennsylvania.

1905. ADLER, LEWIS H., JR., M.D., Professor of Diseases of the Rectum in the Philadelphia Polyclinic and College for Graduates in Medicine; formerly Prosector to the Professor of Anatomy in the University of Pennsylvania; Consulting Surgeon to the Charity Hospital. 1610 Arch St.

1914. AIKEN, THOMAS GERALD, M.D., Assistant Visiting Physician to the Chester County Hospital, West Chester, Pa.; Pathologist to the Country Branch of the Rush Hospital for Tuberculosis. Berwyn, Pa.

1913. ALEXANDER, EMORY G., M.D., Surgeon to St. Christopher's Hospital for Children; Associate Surgeon to the Episcopal Hospital; Clinical Professor of Surgery in the Woman's Medical College of Pennsylvania, Demonstrator of Fracture Dressings in the Jefferson Medical College, and Assistant

ELECTED

Surgeon to the Kensington Hospital for Women. 1701 Spruce St.

1906. Allen, Francis Olcott, Jr., A.B., M.D., Surgeon to the Presbyterian and Bryn Mawr Hospitals; Associate Surgeon to the Pennsylvania Hospital. 2216 Walnut St.

1896. Allyn, Herman B., M.D., Physician to the Philadelphia General Hospital. 2044 Chestnut St.

1888. Anders, James M., M.D., L.L.D., Professor of Medicine and Clinical Medicine in the Medico-Chirurgical College; Officer de l'Instruction Publique. 1605 Walnut St.

1905. Anspach, Brooke M., M.D., Professor of Gynecology in the Jefferson Medical College; Attending Gynecologist, Jefferson Hospital; Gynecologist to the Stetson Hospital; Attending Gynecologist to the Bryn Mawr Hospital. 1827 Spruce St.

1905. Appleman, Leighton F., M.D., Demonstrator of Pharmacy and Materia Medica, and Instructor in Therapeutics in the Jefferson Medical College; Associate Professor of Ophthalmology in the University of Pennsylvania Graduate School of Medicine; Assistant Surgeon to the Wills Eye Hospital; Ophthalmologist to the Frederick Douglass Memorial Hospital and to the Burd School. 308 S. Sixteenth St.

1906. Ashhurst, Astley Paston Cooper, A.B., M.D., Associate Professor of Surgery in the University of Pennsylvania; Surgeon to the Episcopal Hospital and to the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases. 2104 Spruce St.

1893. Ashton, Thomas G., M.D., Physician to the Philadelphia General Hospital. 1814 S. Rittenhouse Square.

1920. Astley, George Mason, M.D., Assistant Surgeon, Samaritan Hospital. 5317 Master St.

1914. Austin, J. Harold, B.S. (Univ. of Penna.), M.D., Professor of Research Med., University of Pennsylvania. Department Research Medicine, University of Pennsylvania.

1906. Babbitt, James A., A.B., (Yale), A.M. (Haverford), M.D., Associate Professor of Oto-Laryngology, University of Pennsylvania; Graduate School of Medicine; Instructor in Otology, University of Pennsylvania School of Medicine; Assistant Laryngologist and Aurist, Lankenau Hospital;

ELECTED

Laryngologist and Aurist, Children's Hospital: Out-Patient Department. 2117 Chestnut St.

1910. BAER, BENJAMIN F., JR., B.S., M.D., Associate Professor of Ophthalmology; Graduate School of Medicine, University of Pennsylvania; Instructor in Ophthalmology, Medical Department, University of Pennsylvania; Assistant Ophthalmologist, University Hospital; Ophthalmologist, St. Agnes' Hospital. 2039 Chestnut St.

†1892. BAKER, GEORGE FALES, B.S., M.D. 1818 Spruce St.

1911. BALDWIN, JAMES HARVEY, A.B., M.D., Assistant Surgeon to the Methodist Hospital. 1426 Pine St.

1889. BALDY, JOHN MONTGOMERY, M.D., Professor of Gynecology in the Philadelphia Polyclinic; Surgeon to the Gynecean Hospital; Consulting Surgeon to the Jewish and the Frederick Douglass Memorial Hospitals. Devon, Pa.

1916. BALENTINE, PERCIVAL L., M.D., Assistant Surgeon, Wills Eye Hospital; Demonstrator of Ophthalmic Surgery in the Philadelphia Polyclinic. 302 Weightman Building, 1524 Chestnut St.

1898. BALLIET, TILGHMAN M., A.M., M.D., Professor of Therapeutics at Dartmouth College, Hanover, N. H.; Physician to the Old Man's Home. 113 S. Fortieth St.

1911. BARNARD, EVERETT P., M.D., Obstetrician to the Maternity Hospital; Assistant Instructor in Obstetrics in the University of Pennsylvania. 245 S. Eighteenth St.

1921. BAUER, EDWARD L., M.D., Consultant Pediatrist, Germantown Hospital; Visiting Physician, Philadelphia Hospital for Contagious Diseases; Assistant Visiting Physician, Children's Hospital of the Mary J. Drexel Home. 6112 Germantown Ave.

1883. BAUM, CHARLES, A.M., M.D., Ph.D. 1828 Wallace St.

1908. BEARDSLEY, EDWARD J. G., M.D., L.R.C.P. (Lond.), Assistant Professor of Medicine in the Jefferson Medical College; Chief Clinical Assistant in the Out-patient Medical Department of the Jefferson Medical College Hospital; Assistant Physician to the Jefferson Hospital. 258 S. Sixteenth St.

*1916. BELL, WILLIAM HEMPHILL, M.D., Captain, Medical Corps, U. S. Navy, Medical Aide to Commander-in-Chief and Fleet Surgeon, U. S. Pacific Fleet. Flagship U. S. Pacific Fleet, care Postmaster, San Francisco, Cal.

*1896. BEYEA, HENRY D., M.D. Ware Neck, Va.

ELECTED

*1903. BIGGS, MONTGOMERY H., M.D., Surgeon to the Rutherford Hospital; Chief Surgeon of the Carolina, Churchfield and Ohio Railway. Rutherfordton, N. C.

1918. BILLINGS, ARTHUR E., M.D. 1703 Spruce St.

1917. BIRDSALL, JOSEPH C., A.B., A.M., M.D., Urologist, Polyclinic Section of the Medico-Chirurgical College and Hospital Graduate School of Medicine of the University of Pennsylvania; Assistant in Genito-urinary Dispensary, Presbyterian Hospital; Instructor in Surgery, University of Pennsylvania. 4610 Spruce St.

1908. BLAND, PASCAL BROOKE, M.D., Chief Clinical Assistant in the Gynecological Department of the Jefferson Medical College Hospital; Instructor in Gynecology in the Jefferson Medical College; Gynecologist to St. Joseph's Hospital; Assistant Gynecologist to the Philadelphia General Hospital. 1621 Spruce St.

1917. BLOCK, FRANK B., A.B., M.D., Surgeon to the Jewish Hospital; Instructor in Gynecology in the University of Pennsylvania. 2035 Chestnut St.

1894. BOCHROCH, MAX H., M.D., Neurologist to the St. Joseph's and Jewish Hospitals; Physician to the Psychopathic Wards of the Philadelphia General Hospital. 1539 Pine St.

1896. BOGER, JOHN A., A.M., M.D., Surgeon to St. Mary's Hospital; Surgeon to the Stetson Hospital; Surgeon to the Dispensary of the Episcopal Hospital. 2213 N. Broad St.

1910. BOICE, J. MORTON, A.B., M.D., Physician to the Home of the Merciful Savior for Crippled Children. 4020 Spruce Street.

1911. BONNEY, CHARLES W., A.B., M.D., Associate in Topographic and Applied Anatomy in the Jefferson Medical College. 1117 Spruce St.

1921. BORZELL, FRANCIS FRANK, M.D., Roentgenologist, Frankford Hospital; Chief Clinical Assistant, Roentgen Department, Jefferson Medical College; X-Ray Consultant, State Hospital for the Insane, Norristown, Pa. 1933 Chestnut St.

1913. BOSTON, L. NAPOLEON, A.M., M.D., Professor of Physical Diagnosis in the Medico-Chirurgical College; Physician to the Philadelphia General Hospital; Pathologist to the Frankford Hospital. 2024 Chestnut St.

ELECTED

1919. Bowen, David Ralph, M.D., Radiologist to the Pennsylvania Hospital; Assistant Professor in Radiology; Graduate School of Medicine, University of Pennsylvania. 82 W. Lacrosse Ave., Lansdowne, Pa.

1891. Boyd, George M., M.D., Professor of Obstetrics, Graduate School of Medicine, University of Pennsylvania; Obstetrician and Gynecologist to the Philadelphia Lying-in Charity; Obstetrician and Gynecologist to the Medico-Chirurgical Hospital. 1909 Spruce St.

1907. Boyer, Henry Percival, M.D., Neurologist to the Stetson Hospital; Physician to the Philadelphia Home for Incurables; Assistant Physican to the Orthopædic Hospital and Infirmary for Nervous Diseases. 4602 Baltimore Ave.

1907. Bradley, William N., Ph.G., M.D., Visiting Pediatrist to Howard Hospital; Visiting Pediatrist to Philadelphia General Hospital; Instructor in Pediatrics in the University of Pennsylvania; Instructor in Pediatrics, Post-graduate School, University of Pennsylvania. 1725 Pine St.

1921. Bransfield, John W., M.D., Visiting Surgeon to St. Agnes and St. Vincent's Hospital. 2025 Walnut St.

1903. Branson, Thomas F., M.D., Attending Physician to the Bryn Mawr Hospital. Rosemont, Pa.

1891. Brinton, Lewis, M.D., Physician-in-Chief to the American Hospital for Diseases of the Stomach. 1301 Medical Arts Bldg., Sixteenth and Walnut Sts.

1900. Brinton, Ward, A.M., M.D., Visiting Physician to the Tuberculosis Department of the Philadelphia General Hospital; Visiting Physician, Eagleville Sanatorium; Clinical Professor of Medicine, Woman's Medical College; Instructor in Medicine, University of Pennsylvania. 1423 Spruce St.

1917. Bromer, Ralph S., A.B. (Yale University), M.D., Roentgenologist to the Episcopal and the Orthopædic Hospitals. 4429 Walnut St.

*1907. Brooks, Macy, A.B. (Princeton), M.D., Care Morgan, Harjes & Co., Paris, France.

1919. Brown, H. MacVeagh, M.D., Associate Physician, Presbyterian Hospital. 4608 Baltimore Ave.

1919. Browh, Henry P., Jr., M.D., Assistant Surgeon, Presbyterian and Pennsylvania Hospitals; Dispensary Surgeon, Children's Hospital. 1822 Pine St.

1916. Brown, Samuel Horton, M.D. 1901 Mt. Vernon St.

ELECTED

1887. Brubaker, Albert P., A.M., M.D., Professor of Physiology and Medical Jurisprudence in the Jefferson Medical College; Professor of Physiology and Hygiene in the Drexel Institute of Science, Art, and Industry. 3426 Powelton Ave.

1916. Buckley, Albert Coulson, M.D., Medical Superintendent, Friends' Hospital, Frankford; Associate Professor of Psychiatry, Graduate School of Medicine, University of Pennsylvania; Alienist to the Orthopædic Hospital and Infirmary for Nervous Diseases. Frankford, Phila.

1906. Burns, Stillwell C., M.D., Associate Professor of Surgery in the Graduate School of Medicine, University of Pennsylvanian. 1925 Spring Garden St.

1892. Burr, Charles W., M.D., Professor of Mental Diseases in the University of Pennsylvania; Neurologist to the Philadelphia General Hospital. 1918 Spruce St.

1906. Butler, Ralph, M.D., Professor of Diseases of the Nose and Throat in the Philadelphia Polyclinic and the College for Graduates in Medicine; Chief of the Dispensary for Diseases of the Ear at the University Hospital; Assistant Professor of Otology in the University of Pennsylvania; Laryngologist and Aurist to the Lankenau Hospital. 1926 Chestnut St.

*1908. Cadbury, William W., A.M., M.D., Canton Christian College, Canton, China.

†1907. Cadwalader, Williams B., M.D., Instructor in Neurology and Neuropathology, University of Pennsylvania, School of Medicine; Neurologist to the Presbyterian Hospital; Consulting Neurologist to the Bryn Mawr Hospital. 1206 Medical Arts Building.

1905. Cameron, George A., M.D., Physician to the Germantown Hospital. S. E. cor. Schoolhouse Lane and Greene St., Germantown.

1905. Carmany, Harry S., M.D., Surgeon to St. Timothy's Hospital, Roxborough; Associate Surgeon of the Episcopal Hospital; Surgeon to the Dispensary of the Episcopal Hospital. 366 Green Lane, Roxborough.

1910. Carnett, John Berton, M.D., Professor of Surgery, Postgraduate Medical School, University of Pennsylvania; Associate in Surgery, Medical Department, University of Pennsylvania; Surgeon to Philadelphia General Hospital; Chief Surgeon to the American Stomach Hospital. 123 S. Twentieth St.

ELECTED

1905. CARPENTER, HERBERT B., M.D., Physician to the Dispensary of the Children's Hospital. 1805 Spruce St.

1895. CARPENTER, JOHN T., M.D., Attending Ophthalmologist to the Bryn Mawr Hospital. 2030 Chestnut St.

1917. CARSON, JOHN B., M.D., Physician to Episcopal Hospital; Assistant Physician, Pennsylvania Hospital. 1802 Pine St.

1900. CHANCE, BURTON, M.D., Attending Surgeon to the Wills Eye Hospital; Consulting Ophthalmologist Eastern Pennsylvania Institution for the Feeble-minded and Epileptic; Ophthalmic Surgeon to the Pennsylvania Railroad Company. 1305 Spruce St.

1897. CHESTON, RADCLIFFE, M.D., Visiting Physician to the Chestnut Hill Hospital; Consulting Physician to the Germantown Hospital, and to the Pennsylvania Institution for the Deaf and Dumb. Chestnut Hill.

1903. CHRYSTIE, WALTER, M.D. One of the Senior Physicians to Bryn Mawr Hospital. Bryn Mawr, Pa.

1899. CLARK, JOHN G., M.D., Professor of Gynecology in the University of Pennsylvania; Gynecologist-in-Chief to the University Hospital. 2017 Walnut St.

1896. CLEVELAND, ARTHUR H., M.D., Clinical Professor of Laryngology in the Medico-Chirurgical College; Laryngologist to the Medico-Chirurgical Hospital; Laryngologist and Aurist to the Presbyterian Hospital, and to Pennsylvania Institution for Deaf and Dumb. 256 S. Fifteenth St.

1910. CLOUD, J. HOWARD, M.D., Assistant Physician to the Bryn Mawr Hospital; Attending Physician to the Children's House of Bryn Mawr Hospital. 11 W. Montgomery Ave., Ardmore, Pa.

1903. COATES, GEORGE MORRISON, A.B., M.D., Professor of Otology, University of Pennsylvania, Graduate School of Medicine; Associate Surgeon, Ear, Throat, and Nose, Pennsylvania Hospital; Consulting Laryngologist to the Philadelphia Orphanage and to the Sharon Hospital, Sharon, Conn. 1811 Spruce St.

1908. CODMAN, CHARLES A. E., M.D., Physician to the American Oncologic Hospital. 4116 Spruce St.

1907. COHEN, MYER SOLIS, A.B., M.D., Pediatrist to the Jewish Hospital and to the Eagleville Sanatorium; Director of the Jules E. Mastbaum Research Laboratory of the Jewish Hospital; Assistant Professor in Medicine, Graduate

ELECTED

School of Medicine, University of Pennsylvania. 1833 Pine St.

1888. Cohen, Solomon Solis, M.D., Professor of Clinical Medicine in the Jefferson Medical College; Physician to the Jefferson Medical College Hospital, to the Philadelphia General Hospital, to the Jewish Hospital, and to the Rush Hospital. 1525 Walnut St.

1920. Cole, Charles J., A.B., M.D., Visiting Physician, Philadelphia Hospital for Contagious Diseases; Assistant Pediatrist, Polyclinic Hospital; Physician to Out-patient Department, Mary Drexel Home; Assistant Physician to Out-patient Department, Children's Hospital, University Hospital. Elkins Park, Pa.

1898. Coles, Stricker, M.D., Assistant Professor of Obstetrics in the Jefferson Medical College; Assistant Obstetrician to the Jefferson and the Philadelphia General Hospitals; Visiting Physician to the Philadelphia Lying-in-Charity Hospital. 2103 Walnut St.

*1901. Coley, Thomas Luther, A.B., M.D., Major Medical Corps, U. S. Army, Fitzsimmons General Hospital, Denver, Colo.

1903. Coplin, W. M. L., M.D., Professor of Pathology in the Jefferson Medical College; Pathologist to and Director of the Laboratories of the Jefferson Medical College Hospital; Pathologist to the Philadelphia General Hospital and to the Friends' Asylum for the Insane, Frankford; Bacteriologist to the Pennsylvania State Board of Health. 606 S. Forty-eighth St.

1912. Copp, Owen, A.B., M.D., Physician-in-chief and Superintendent of the Pennsylvania Hospital for the Insane. Pennsylvania Hospital for the Insane, Forty-fourth and Market Sts.

1911. Cornell, Walter Stewart, A.B., M.D., Director of Medical Inspection of Public Schools of the City of Philadelphia; Chief of Medical Staff of the House of Detention; Lecturer on Osteology in the University of Pennsylvania. 729 City Hall.

1914. Corson, Edward Foulke, M.D., Assistant Dermatologist, Jefferson Hospital and Children's Hospital Dispensary; Chief Clinical Assistant in the Skin Dispensary, Jefferson Hospital. 2039 Chestnut St.

1907. Council, Malcolm S., M.D., Attending Physician to the Bryn Mawr Hospital; Attending Physician to the Cathcart Home at Devon. Bryn Mawr, Pa.

ELECTED

*1909. Craig, Alexander R., A.M., M.D., Sc.D. 535 N. Dearborn St., Chicago, Ill.

1904. Craig, Frank A., M.D., Instructor in Medicine in the University of Pennsylvania; Visiting Physician to the Henry Phipps Institute, University of Pennsylvania; Visiting Physician to the White Haven Sanatorium; Tuberculosis Consultant to the Presbyterian Hospital. 1818 S. Rittenhouse Square.

1907. Crampton, George S., M.D., Attending Surgeon to the Eye Department of the Pennsylvania Hospital and the Philadelphia Hospital for Contagious Diseases; Assistant Surgeon to the Wills Hospital; Lecturer on Physiologic Optics in the Philadelphia Polyclinic and School for Graduates in Medicine; Ophthalmologist to the Philadelphia Orphanage. 1700 Walnut St.

1920. Creighton, William J., B.A., M.D., Assistant Ophthalmic Surgeon, Germantown Hospital and Dispensary; Assistant Dispensary Surgeon, Department Ophthalmology, University Hospital; Instructor in Ophthalmology, University of Pennsylvania Medical School. 1905 Chestnut St.

1920. Cross, George Howard, M.D., Ophthalmologist to the Chester Hospital. Chester, Pa.

1917. Cross, Sumner H., A.B., M.D., Physician to the Abington Memorial Hospital, Abington, Pa. 412 York Road, Jenkintown, Pa.

1921. Crossan, Edward T., M.D., 2104 Spruce St.

1904. Cruice, John M., M.D., Physician to the Henry Phipps Institute of the University of Pennsylvania; Physician to the Medical Dispensary of St. Agnes' Hospital; Instructor in Medicine in the University of Pennsylvania. 1932 Spruce St.

*1910. Cummins, W. Taylor, M.D., Pathologist to the Southern Pacific Hospital; Director of the Mary W. Harriman Research Laboratory, San Francisco, Cal.

1902. Currie, Charles A., M.D., Physician to the Germantown Hospital. West Walnut Lane, Germantown.

1896. Da Costa, John Chalmers, M.D., Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to the Philadelphia General and St. Joseph's Hospitals. 2045 Walnut St.

1887. Daland, Judson, M.D., Professor of Medicine in the Graduate School of Medicine, University of Pennsylvania. 317 S. Eighteenth St.

ELECTED

°1859. Darrach, James, M.D., Consulting Surgeon to the Germantown Hospital. Preston Apartments, Atlantic City, N. J.

1919. Davies, John R., Jr., M.D., 302 S. Nineteenth St.

1896. Davis, Charles N., M.D., Dermatologist to the Pennsylvania Hospital; Consulting Dermatologist to St. Agnes' Hospital; Assistant Physician to the Dispensary for Skin Diseases in the Howard Hospital. 1931 Spruce St.

1888. Davis, Edward P., A.M., M.D., Professor of Obstetrics in the Jefferson Medical College; Obstetrician to the Jefferson Hospital; Obstetrician and Gynecologist to the Philadelphia General Hospital; Consultant to the Preston Retreat. 250 S. Twenty-first St.

1916. Davis, Warren B., M.D., Oral Surgeon, Philadelphia General Hospital; Assistant Rhinologist and Otologist St. Agnes' Hospital; Assistant Demonstrator of Anatomy Jefferson Medical College; Clinical Assistant in Surgical Dispensary Jefferson Hospital. 135 S. Eighteenth St.

1900. Davisson, Alex. Heron, M.D. 4514 Springfield Ave.

1894. Deaver, Harry C., M.D., Professor of Surgery in the Woman's Medical College of Pennsylvania; Surgeon to the Episcopal Hospital, and to the Children's Hospital of the Mary J. Drexel Home; Surgeon-in-Chief to the Kensington Hospital for Women. 1701 Spruce St.

1887. Deaver, John B., M.D., D.Sc., LL.D., John Rea Barton Professor of Surgery, University of Pennsylvania; Visiting Surgeon, Hospital of the University of Pennsylvania; Surgeon-in-Chief to the Lankenau Hospital. 1634 Walnut Street.

1902. Dehoney, Howard, M.D. 240 S. Thirteenth St.

1885. Dercum, Francis X., A.M., M.D., Ph.D., Professor of Nervous and Mental Diseases in the Jefferson Medical College; Consulting Neurologist to the Philadelphia General Hospital; Foreign Corresponding Member of the Neurological Society of Paris, and Corresponding Member of the Psychiatric and Neurological Society of Vienna. 1719 Walnut St.

1908. Despard, Duncan L., M.D., Surgeon to the Abington Memorial Hospital; Assistant Surgeon to the Jefferson Medical College Hospital; Demonstrator of Clinical Surgery in the Jefferson Medical College; Associate in Gynæcology in the Philadelphia Polyclinic Hospital. 1806 Pine St.

1912. Dewey, J. Hiland, Ph.B., M.D., Assistant Surgeon to Wills Eye Hospital; Ophthalmic Surgeon to St. Francis' Hospital, Trenton, N. J. 1436 Diamond St.

ELECTED

*1911. Dickson, Frank D., M.D. 405 Waldheim Bldg., Kansas City, Mo.

1908. Dillard, Henry K., Jr., M.D., Physician to the Out-patient Department of the Pennsylvania Hospital; Physician to the Dispensary of the Mary J. Drexel Home. 234 S. Twentieth St.

1920. Diven, John, A.B., M.D., Pediatrician to St. Christopher's Hospital and Babies' Hospital of Philadelphia; Assistant Pediatrician to Presbyterian Hospital, 2038 Chestnut St.

1920. Doane, Joseph Chapman, M.D., Medical Director Philadelphia General Hospital. Superintendent, Bureau of Hospitals.

*1897. Dorland, W. A. Newman, A.M., M.D., Professor of Gynecology in the Post-graduate Medical School of Chicago; Professor of Obstetrics in the Chicago College of Medicine and Surgery; Visiting Obstetrician to Cook County Hospital. 7 West Madison St., Chicago, Ill.

1907. Dorrance, George Morris, M.D., Surgeon to St. Agnes' Hospital; Demonstrator of Applied Anatomy in the Dental Department of the University of Pennsylvania. 2025 Walnut St.

1902. Downs, Robert N., Jr., M.D., Surgeon to the Dispensary of the Germantown Hospital. 6008 Greene St., Germantown.

1910. Drayton, William, Jr., M.D., Physician to the Philadelphia Hospital for Contagious Diseases; Physician to the Out-patient Department of the Pennsylvania Hospital; Physician to the Pennsylvania Institute for the Instruction of the Blind; Assistant Physician to the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases. 1316 Locust St.

1911. Earnshaw, Henry Culp, M.S., M.D., Attending Physician to the Hospital of the Good Shepherd, Rosemont; Assistant Attending Physician to the Bryn Mawr Hospital; Attending Physician to the Bryn Mawr Children's Hospital; Pennsylvania Railroad Surgeon. Bryn Mawr, Pa.

*1887. Edwards, William A., M.D., Professor of Pediatrics in the Medical Department of the University of California. Fifth and Spring Sts., Los Angeles, Cal.

1911. Eliason, Eldridge E., B.A., M.D., Associate in Surgery in the University of Pennsylvania; Surgeon to the Howard Hospital; Assistant Surgeon to the University of Pennsyl-

ELECTED

vania Hospital, the Philadelphia General Hospital and the American Stomach Hospital. 330 S. Sixteenth St.

1904. Elmer, Walter G., B.S., M.D., Associate Professor of Orthopædic Surgery in the Graduate School of Medicine of the University of Pennsylvania; Associate Orthopædic Surgeon to the Polyclinic Hospital; Orthopædic Surgeon to the Jewish Hospital and to the Philadelphia General Hospital. 1801 Pine St.

1896. Ely, Thomas C., A.M., M.D. 3912 Chestnut St.

1901. Erck, Theodore A., M.D. 251 S. Thirteenth St.

1893. Eshner, Augustus A., M.D., Consulting Physician to Mercy Hospital. 1019 Spruce St.

*1905. Evans, Joseph S., Jr., A.B., M.D., Professor of Clinical Medicine in the University of Wisconsin; Consulting Physician, Madison General Hospital. 524 N. Francis St., Madison, Wis.

1905. Evans, William, M.D. 4007 Chestnut St.

1912. Eves, Curtis C., M.D., Aural and Laryngeal Surgeon to the Episcopal Hospital; Assistant in the Out-patient Department for Diseases of the Ear, Throat, and Nose of the Pennsylvania Hospital; Demonstrator of Operative Surgery of the Ear, Nose, and Throat in the Philadelphia Polyclinic. 247 S. Seventeenth St.

1894. Faries, Randolph, M.D. 2007 Walnut St.

*1903. Farr, Clifford B., A.M., M.D., Division of Diagnosis and Research, B. F. Goodrich Co. 88 Casterton Ave., Akron, Ohio.

1893. Farr, William W., M.D., Physician to the Leamy Home. 20 W. Ashmead Place, Chestnut Hill.

1884. Fenton, Thomas H., M.D., Ophthalmic Surgeon to St. Vincent's Home, the Baptist Home and the Widener Home for Crippled Children. 1319 Spruce Street.

1907. Fetterolf, George, A.B., M.D., Sc.D., Laryngologist to the Henry Phipps Institute for Tuberculosis; Laryngologist to the White Haven Sanatorium; Consulting Laryngologist to the Phœnixville Hospital; Demonstrator of Anatomy in the University of Pennsylvania. 2047 Chestnut St.

1907. Fife, Charles A., A.B., M.D., Associate in Pediatrics in the University of Pennsylvania; Pediatrist to the Presbyterian Hospital; Physician to the St. Christopher's Hospital for Children; Assistant Physician to the Philadelphia General Hospital. 2038 Chestnut St.

ELECTED

1884. Fisher, Henry M., M.D. 1027 Pine St.

1910. Fisher, John Monroe, M.D., Associate Professor of Gynecology in the Jefferson Medical College; Gynecologist to the Philadelphia, St. Agnes', and Pottstown Hospitals; Assistant Gynecologist to the Jefferson Medical College Hospital. 222 S. Fifteenth St.

1888. Flick, Lawrence F., M.D. 736 Pine St.

1916. Forst, John R., M.D. 166 W. Coulter St., Germantown.

1908. Foulkrod, Collin, M.D., Obstetrician to the Presbyterian Hospital; Assistant Demonstrator of Obstetrics in Jefferson Medical College. 3910 Chestnut St.

1908. Fox, Herbert, M.D., Director of the William Pepper Laboratory of Clinical Medicine, University of Pennsylvania; Pathologist to the Laboratory of Comparative Pathology of the Zoölogical Society of Philadelphia; Pathologist to the Rush Hospital; Pathologist to the Children's Hospital. 3902 Locust St.

†1885. Fox, Joseph M., M.D. Torresdale, Pa.

1906. Fraley, Frederick, Jr., A.B., M.D. Overbrook, Pa.

1903. Francine, Albert Philip, A.B., M.A., M.D., Chief of the Division of Tuberculosis, State Department of Health. 264 S. Twenty-first St.

1897. Frazier, Charles H., A.B., M.D., Sc.D., Professor of Clinical Surgery in the University of Pennsylvania; Surgeon to the University Hospital. 1724 Spruce St

1916. Funk, Elmer Hendricks, M.D., Assistant Professor of Medicine in the Jefferson Medical College; Medical Director and Physician-in-Charge of the Department for Diseases of the Chest of Jefferson Hospital; Assistant Physician to the Pennsylvania Hospital; Visiting Physician to the White Haven Sanatorium. 1318 Spruce St.

1910. Furbush, Charles Lincoln, M.D., Director of Public Health, Philadelphia. 4300 Spruce St.

1899. Gamble, Robert G., M.D., one of the Attending Physicians to the Bryn Mawr Hospital. Haverford, Pa.

1912. Gaskill, Henry Kennedy, M.D., Assistant Professor of Dermatology in the Jefferson Medical College; Attending Dermatologist to the Philadelphia General Hospital. N. E. Cor. 16th and Spruce Sts.

1917. Gerhard, Arthur Howell, M.D. 726 Richmond St.

1902. Ghriskey, Albert A., M.D. 3936 Walnut St.

ELECTED

1899. GIBBON, JOHN H., M.D., Professor of Surgery in the Jefferson Medical College; Surgeon to the Pennsylvania Hospital and Consulting Surgeon to the Bryn Mawr Hospital. 1608 Spruce St.

1920. GILL, A. BRUCE, A.B., M.D., Professor of Orthopædic Surgery, University of Pennsylvania; Surgeon to the Orthopædic Hospital; Orthopædic Surgeon to the Episcopal and Presbyterian Hospitals; Chief Surgeon to the Widener Memorial Industrial Training School for Crippled Children. The Lenox, 13th and Spruce Sts.

*1913. GINSBURG, NATHANIEL, M.D. 306 Kresge Building, Detroit, Mich.

1897. GIRVIN, JOHN H., M.D., Gynecologist to the Presbyterian Hospital; Associate Professor of Gynecology Graduate School of Medicine, University of Pennsylvania. 2120 Walnut St.

1920. GITHENS, THOMAS STOTESBURY, M.D. Hamilton Court, 39th and Chestnut Sts.

1906. GITTINGS, J. CLAXTON, M.D., Professor of Pediatrics, Graduate School of Medicine, University of Pennsylvania; Associate in Pediatrics in the University of Pennsylvania, School of Medicine; Visiting Physician to the Children's Hospital of Philadelphia; Assistant Pediatric Physician, University Hospital. 1828 Pine St.

1905. GIVEN, ELLIS E. W., M.D., Surgeon to the Philadelphia Freemasons Memorial Hospital of the Masonic Home, Elizabethtown, Pa.; Surgeon to the Dispensary of the Episcopal Hospital. 2714 Columbia Ave.

1894. GLEASON, E. B., S.B., M.D., LL.D., Professor of Otology in the Medico-Chirurgical College. 2033 Chestnut St.

1906. GOEPP, R. MAX, M.D., Professor of Medicine in the Graduate School of Medicine, University of Pennsylvania. 124 S. Eighteenth St.

1906. GOLDBERG, HAROLD G., M.D., Ophthalmic Surgeon to the Episcopal Hospital and to the Kensington Hospital for Women. 1925 Chestnut St.

1908. GOODMAN, EDWARD H., M.D., Associate in Medicine in the University of Pennsylvania; Consultant to the Medical Dispensary of the University Hospital; Assistant Physician to the University Hospital; Assistant Physician to the Philadelphia General Hospital; Physician to the Presbyterian Hospital. 248 S. Twenty-first St.

ELECTED

1905. Gordon, Alfred, M.D., Neurologist to the Mt. Sinai, the Northwestern General, and the Douglass Memorial Hospitals. 1812 Spruce St.

*†1897. Gould, George M., A.M., M.D. 215 Atlantic Ave., Atlantic City, N. J.

1894. Graham, Edwin E., M.D., Professor of Pediatrics in the Jefferson Medical College; Pediatrist to the Jefferson and the Philadelphia General Hospitals; Physician to the Franklin Reformatory Home. 1713 Spruce St.

1904. Grayson, Charles P., M.D., Professor of Laryngology and Rhinology in the University of Pennsylvania; Physician-in-Charge of the Throat and Nose Department of the University Hospital; Otolaryngologist to the Philadelphia General Hospital. 262 S. Fifteenth St.

1910. Greenman, Milton J., M.D., Sc.D., Director of the Wistar Institute of Anatomy and Biology. Wistar Institute of Anatomy and Biology, Thirty-sixth St. and Woodland Ave.

1883. Griffith, J. P. Crozer, A.B., M.D., Ph.D., Professor of Pediatrics in the University of Pennsylvania; Corresponding Member of the Société de Pédiatrie de Paris; Physician to the Children's Hospital of Philadelphia. 1810 Spruce St.

1912. Griscom, J. Milton, B.S., M.D., Assistant Surgeon to the Wills Eye Hospital; Chief of Clinic of the Eye Dispensary of the Presbyterian Hospital. 1925 Chestnut St.

1911. Gummey, Frank Bird, M.D., Visiting Physician to the Germantown Hospital and Dispensary; Visiting Physician to the Midnight Mission. 5418 Greene St., Germantown.

*1902. Gwyn, Norman B., M.D., Clinician in Medicine, Toronto General Hospital; Clinician in Medicine, Medical Faculty University of Toronto School. 48 Bloor St., E., Toronto, Canada.

1894. Hamill, Samuel McC., M.D., Professor of Diseases of Children in the Philadelphia Polyclinic and College for Graduates in Medicine; Pediatrist to the Presbyterian Hospital; Pediatrist to St. Vincent's Home. 1822 Spruce St.

1897. Hand, Alfred, Jr., M.D., Visiting Physician to the Children's Hospital, to the Children's Hospital of the Mary J. Drexel Home, and to the Methodist Hospital. 1724 Pine St.

1886. Hansell, Howard F., M.D., Professor of Ophthalmology in the Jefferson Medical College; Ophthalmic Surgeon to

ELECTED

the Philadelphia General Hospital and to the Jefferson Medical College Hospital; Emeritus Professor of Diseases of the Eye in the Philadelphia Polyclinic. N. E. Cor. 17th and Walnut Sts

1889. HARE, HOBART A., LL.D., M.D., Professor of Therapeutics, Materia Medica, and Diagnosis in the Jefferson Medical College. 1801 Spruce St.

1903. HART, CHARLES D., A.M., M.D., Inspector and Secretary of the Eastern State Penitentiary; National Executive Committee and Chairman of the Philadelphia Committee, Boy Scouts of America. Chestnut Hill.

1885. HARTE, RICHARD H., M.D., (Hon.) F. R. C. S. Ireland, Adjunct Professor of Surgery in the University of Pennsylvania; Surgeon to the Pennsylvania and the Orthopædic Hospitals; Consulting Surgeon to St. Mary's, St. Timothy's, and the Bryn Mawr Hospitals. 1503 Spruce St.

1888. HARTZELL, MILTON B., A.M., M.D., LL.D., Professor of Dermatology in the University of Pennsylvania. 3644 Chestnut St.

1907. HATFIELD, CHARLES JAMES, A.B (Princeton), M.D., Executive Director of the Henry Phipps Institute for the Study, Treatment, and Prevention of Tuberculosis; Visiting Physician to the White Haven Sanatorium. Phipps Institute, 7th and Lombard Sts.

1872. HAYS, I. MINIS, M.D. 266 S. Twenty-first St.

1911. HEED, CHARLES R., M.D., Ophthalmologist to Girard College; Assistant Ophthalmologist to the Jefferson Medical College Hospital. 1205 Spruce St.

1908. HEINEBERG, ALFRED, P.D., M.D., Associate in Gynecology in the Jefferson Medical College; Assistant Gynecologist to St. Agnes' Hospital. N. E. Cor. 16th and Spruce Sts.

1901. HEISLER, JOHN C., M.D., Professor of Anatomy in the Medico-Chirurgical College. 3829 Walnut St.

1903. HENRY, J. NORMAN, M.D., Physician to the Pennsylvania Hospital; Clinical Professor of Medicine in the Woman's Medical College of Pennsylvania; Assistant Physician to the Philadelphia General Hospital. 1906 Spruce St.

1891. HEWSON, ADDINELL, A.B., A.M., M.D., Professor of Anatomy in the Philadelphia Polyclinic and College for Graduates in Medicine; Professor of Anatomy and Histology in the Temple University; Surgeon to St. Timothy's Hospital, Roxborough. 2120 Spruce St.

ELECTED

1909. HIGBEE, WILLIAM S., M.D., President of the Pennsylvania State Board of Examiners for Registration of Nurses. 1703 S. Broad St.

1897. HINKLE, WILLIAM M., M.D., Lecturer on the Anatomy and Physiology of the Vocal Organs in the National School of Elocution and Oratory. 1323 N. Thirteenth St.

*1892. HINSDALE, GUY, A.M., M.D. Hot Springs, Virginia.

*1888. HIRSH, A. BERN, M.D. 71 West 94th St., New York City.

1888. HIRST, BARTON COOKE, A.B., M.D., LL.D., Professor of Obstetrics in the University of Pennsylvania; Gynecologist to the Philadelphia General and the Howard Hospitals. 1821 Spruce Street.

1903. HIRST, JOHN COOKE, M.D., Associate in Obstetrics, University of Pennsylvania; Obstetrician to St. Agnes' Hospital; Gynecologist and Obstetrician to the Philadelphia General Hospital; Gynecologist to Mt. Sinai Hospital. 1823 Pine St.

*1908. HITCHENS, ARTHUR PARKER, M.D., Assistant Professor of Bacteriology, Protozoölogy and Preventive Medicine, Army Medical School. Washington, D. C.

1905. HODGE, EDWARD BLANCHARD, A.B., M.D., Surgeon to the Presbyterian and the Children's Hospitals; Associate Surgeon to the Pennsylvania Hospital; Associate Surgeon to the Widener Memorial Training School. 2019 Spruce St.

1913. HOFFMAN, CLARENCE, M.D., 1621 Pine St.

°1885. HOLLAND, JAMES W., A.M., M.D., Sc.D., Emeritus Professor of Medical Chemistry and Toxicology and Dean of the Jefferson Medical College. 2006 Chestnut St.

1906. HOLLOWAY, THOMAS B., M.S., M.D., Vice-Dean for and Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania, Instructor in Ophthalmology in the University of Pennsylvania; Attending Surgeon to the Wills Hospital; Ophthalmologist to the Pennsylvania Institution for the Instruction of the Blind at Overbrook. 1819 Chestnut St.

1914. HOOKER, RICHARD S., M.D. 2147 N. Howard St.

1919. HOPKINS, ARTHUR H., M.D. 1726 Pine St.

1908. HOYT, DANIEL M., M.D., Assistant Visiting Physician to the Philadelphia General Hospital. The Tracy, 36th and Chestnut Sts.

*1912. HUBER, G. CARL, M.D., Professor of Anatomy and Director of the Anatomic Laboratories in the University of Michigan. 1330 Hill St., Ann Arbor, Mich.

ELECTED

1892. HUGHES, WILLIAM E., M.D., Visiting Physician to the Philadelphia General Hospital; Consulting Physician to the Presbyterian Hospital. 3945 Chestnut St.

1912. HUNTER, JOHN W., B.S., M.D. 4715 Chester Ave.

1921. HUNTER, ROBERT J., M.D., Laryngologist Philadelphia General Hospital; Chief of Dispensary and Assistant Laryngologist and Aurist, Presbyterian and Howard Hospitals; Instructor in Otology, University of Pennsylvania, Graduate School. 1825 Chestnut St.

1898. HUTCHINSON, JAMES P., M.D., Surgeon to the Pennsylvania, the Methodist, the Children's, St. Timothy's, and the Bryn Mawr Hospitals; Adjunct Professor of Surgery in the University of Pennsylvania. 133 S. Twenty-second St.

°1871. INGHAM, JAMES V., M.D. 1811 Walnut St.

1921. IVY, ROBERT H., D.D.S., M.D., Professor of Clinical Maxillo-Facial Surgery, University of Pennsylvania; Oral Surgeon to the Hospitals of the Graduate School of Medicine, University of Pennsylvania and to the Philadelphia General Hospital; Consultant in Maxillo-Facial Surgery, Walter Reed General Hospital, Washington, D. C. 1503 Medical Arts Building.

1917. JACKSON, CHEVALIER, M.D., Professor of Laryngology, Jefferson Medical College; Professor of Bronchoscopy and Esophagoscopy, Graduate School of Medicine, University of Pennsylvania. 128 S. Tenth St.

*1885. JACKSON, EDWARD, A.M., M.D., Sc.D., Professor of Ophthalmology in the University of Colorado; Emeritus Professor of Diseases of the Eye in the Philadelphia Polyclinic. 318 Majestic Building, Denver, Col.

*1906. JACOBS, FRANCIS BRINTON, B.S., M.D., Assistant Surgeon to the Chester County Hospital. Whitford, Pa.

1920. JANVIER, G. VICTOR, M.D., Instructor in Obstetrics, University of Pennsylvania; Assistant Obstetrician to the Philadelphia General Hospital and the University of Pennsylvania Hospital; Associate in Gynecology at the American Stomach Hospital. Lansdowne, Pa.

1913. JEFFERYS, WILLIAM HAMILTON, A.B., A.M., M.D. New Street, Chestnut Hill.

1919. JENKS, HORACE H., M.D. 918 Clinton St.

ELECTED

1898. Johnson, Russell H., A.B. (Princeton), M.D., Physician to the Pennsylvania Institution for the Deaf and Dumb. Chestnut Hill, Philadelphia.

1918. Jonas, Leon, M.D. 2253 N. 17th St.

1900. Jones, Charles James, A.M., M.D., LL.D., Ophthalmic Surgeon to St. Joseph's Hospital; Ophthalmic Surgeon to the House of the Good Shepherd, Germantown; Consulting Ophthalmologist to St. Vincent's Home. 256 S. Fifteenth St.

1913. Jones, John F. X., B.S., A.B., A.M., M.D., Instructor in Surgery in the Jefferson Medical College; Surgeon to St. Joseph's, the Misericordia and St. Agnes Hospitals. 103 S. 21st St.

1900. Jopson, John H., M.D., Professor of Surgery Graduate School, University of Pennsylvania; Associate in Surgery in the University of Pennsylvania; Surgeon to the Presbyterian and the Children's Hospital. 1824 Pine St.

1900. Judson, Charles F., A.B., M.D., Physician to St. Christopher's Hospital for Children, to the Southern Home for Destitute Children and to the Sheltering Arms. 1005 Spruce Street.

1902. Jump, Henry D., M.D., Assistant Physician to Philadelphia General Hospital; Physician to the Misericordia Hospital. 2019 Walnut St.

1886. Jurist, Louis, M.D. 1308 N. Broad St.

1903. Kalteyer, Frederick J., M.D., Demonstrator of Clinical Medicine in the Jefferson Medical College; Chief of the Out-patient Department, Assistant Attending Physician, and Hematologist to the Jefferson Medical College Hospital; Pathologist to Philadelphia Lying-in Charity. 2003 Chestnut St.

*1910. Karsner, Howard T., M.D., Professor of Pathology in the Western Reserve University Medical School. Lakeside Hospital, Cleveland, Ohio.

1920. Keating, Peter McCall, M.D., Chief of Surgical Dispensary, St. Agnes Hospital; Assistant Attending Surgeon, Bryn Mawr Hospital; Assistant, Surgical Out-patient Department, Pennsylvania Hospital; Pathologist, Chester County Hospital. Wawa, Pa.

†1867. Keen, William W., M.D., LL.D., Sc.D. (Hon.) Ph.D. (Hon.), F.R.C.S. (Eng., Edin. and Ire.), Emeritus Professor of the

ELECTED

Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Associé Etranger de l'Academie de Médecin, Paris; Honorary Member of the Société Belge de Chirurgie; Honorary Fellow Royal Society of Medicine, London, Honorary F.A.C.S. 1729 Chestnut St.

1912. Keene, Floyd E., M.D., Instructor in Gynecology in the University of Pennsylvania; Assistant Gynecologist to the University Hospital; Gynecologist to the Chestnut Hill Hospital. Medical Arts Bldg.

1913. Kelly, Francis Joseph, M.D. 2035 Chestnut St.

*1887. Kelly, Howard A., A.B., M.D., LL.D. (Aberdeen, Wash. and Lee, and Univ. of Pa.), Professor of Gynecology in Johns Hopkins University and Gynecologist to the Johns Hopkins Hospital, Baltimore, Md.; Hon. Fellow of the Edinburgh Obstetrical Society, the Royal Academy of Medicine of Ireland, and of the Glasgow Obstetrical and Gynecological Society. 1418 Eutaw Place, Baltimore, Md.

1909. Kelly, James A., A.M., M.D., Visiting Surgeon to St. Mary's and St. Timothy's Hospitals; Associate in Surgery in the Philadelphia Polyclinic and College for Graduates in Medicine; Assistant Visiting Surgeon to St. Joseph's Hospital. 1815 Spruce St.

1912. Kelly, Thomas C., A.M., M.D., Assistant Instructor of Medicine in the University of Pennsylvania; Pediatrician to St. Mary's Hospital; Physician to Out-patient Department of Germantown Hospital. 105 School Lane, Germantown.

1898. Kempton, Augustus F., M.D. 2118 Pine St.

1905. Kercher, Delno E., M.D. 1534 Pine St.

1921. Kern, Richard A., A.B., M.D., Assistant Physician, University Hospital; Instructor in Medicine, University of Pennsylvania. 906 Medical Arts Building.

1920. Klauder, Joseph Victor, M.D., Associate Professor, Dermatology and Syphilology, Graduate School of Medicine, University of Pennsylvania; Dermatologist to the Misericordia Hospital. 1922 Spruce St.

1920. Klein, Thomas, M.D., Associate Professor of Medicine, Graduate School, University of Pennsylvania; Assistant Physician, Presbyterian Hospital. 1717 Pine St.

1913. Klopp, Edward J., M.D., Instructor in Surgery in the Jefferson Medical College; Assistant Surgeon to the Germantown Hospital; Chief Clinical Assistant in the Surgical Department of the Jefferson Hospital; Assistant Surgeon to the

ELECTED

Out-patient Department of the Pennsylvania Hospital 1611 Spruce St.

1895. Kneass, Samuel S., M.D., Associate in the William Pepper Laboratory of Clinical Medicine in the University of Pennsylvania. 1510 Walnut St.

1908. Knipe, Jay C., M.D., Ophthalmologist to the Jewish Hospital; Assistant Ophthalmologist to the Philadelphia General Hospital, and to the Mary J. Drexel Home; Chief of the Eye Clinic at the Jefferson Medical College Hospital; Demonstrator of Osteology and Syndesmology in the Jefferson Medical College. 2035 Chestnut St.

1919. Knipe, Norman Leslie, M.D. 2007 Chestnut St.

1908. Knowles, Frank Crozer, M.D., Professor of Dermatology, Jefferson Medical College; Dermatologist to the Presbyterian and Children's Hospitals; Chief of Clinic, Pennsylvania Hospital. 2022 Spruce St.

1914. Kolmer, John A., M.D., Dr. P.H., M.Sc., Professor of Pathology and Bacteriology in the Graduate School of Medicine of the University of Pennsylvania; Head of the Department of Pathology and Bacteriology in the Dermatological Research Laboratories of Philadelphia; Consulting Pathologist to St. Vincent's and Misericordia Hospitals; Consulting Serologist to Memorial and Germantown Hospitals. Cynwyd, Pa.

1904. Krauss, Frederick, M.D., Ophthalmic Surgeon to the Episcopal Hospital; Ophthalmic and Aural Surgeon to St. Christopher's Hospital for Children; Laryngologist to the Abington Hospital; Ear, Nose and Throat Physician to the Children's Seashore House for Invalid Children, Atlantic City, N. J. 1701 Chestnut Street.

1914. Krumbhaar, Edward B., A.B., Ph.D., M.D., Director of Laboratories, Philadelphia General Hospital; Associate Professor of Pathology in the Graduate School of Medicine of the University of Pennsylvania. Box 4310, Chestnut Hill.

1900. Krusen, Wilmer, M.D., Professor of Gynecology in the Medical Department of Temple University; Chief Gynecologist to the Samaritan and the Garretson Hospitals; Consulting Gynecologist to the Charity and Mercy Hospitals. 127 N. Twentieth St.

*1909. Laird, J. Packard, M.D. 34 N. Bayshore Drive, Miami, Florida.

ELECTED

1904. LANDIS, HENRY R. M., M.D., Director of the Clinical and Sociological Departments of the Henry Phipps Institute of the University of Pennsylvania; Assistant Professor in Medicine in the University of Pennsylvania; Visiting Physician to the White Haven Sanatorium. 1818 S. Rittenhouse Square.

1907. LANGDON, H. MAXWELL, M.D., Associate Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Instructor of Ophthalmology, Under-Graduate School, University of Pennsylvania; Ophthalmologist of the Presbyterian, Orthopædic and Children's Hospitals. 2014 Chestnut St.

*1887. LEAMAN, HENRY, M.D. Leaman Place, Pa.

1920. LEAVITT, FREDERICK HEADLEY, M.D. 1527 Pine St.

1904. LE BOUTILLIER, THEODORE, M.D., Professor of Pediatrics in the Woman's Medical College of Pennsylvania; Pediatrist to the Woman's College Hospital; Physician to the Philadelphia Hospital for Contagious Diseases. 2008 Walnut St.

1893. LE CONTE, ROBERT G., A.B., M.D., Surgeon to the Pennsylvania Hospital; Consulting Surgeon to the Bryn Mawr and Germantown Hospitals. 2000 Spruce St.

1908. LEE, WALTER ESTELL, M.D., Surgeon to the Germantown and Children's Hospitals; Assistant Surgeon to the Pennsylvania and Bryn Mawr Hospitals; Associate Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Consulting Surgeon, Henry Phipps Institute and Pennsylvania State Department of Health. 905 Pine St.

1903. LEFFMANN, HENRY, A.M., M.D., D.D.S., Ph.D., Emeritus Professor of General Chemistry and Hygiene in the Woman's Medical College of Pennsylvania; Honorary Professor of Chemistry in the Wagner Free Institute of Science; Special Lecturer on Research, Philadelphia College of Pharmacy and Science. 1839 N. Seventeenth St.

1892. LEIDY, JOSEPH, M.D., Officier d'instruction publique, France; Consulting Physician to the Pennsylvania Training School for Feeble-minded Children. 1319 Locust St.

1920. LEOPOLD, SIMON S., M.D. 2025 Spruce St.

1915. LEWIS, FIELDING O., M.D., Associate in Laryngology in the Jefferson Medical College Hospital; Operating Clinical Chief of the Laryngological Dispensary and Clinical Assistant of the Otological Dispensary of the Jefferson Medical College

ELECTED

Hospital; Laryngologist of the Philadelphia General Hospital. 261 S. Seventeenth St.

1877. LEWIS, MORRIS J., M.D., Attending Physician to the Orthopædic Hospital and Infirmary for Nervous Diseases and Emeritus Physician to the Pennsylvania Hospital. 1316 Locust St

1911. LEWIS, PAUL A., M.D., Director of the Pathological Department of the Henry Phipps Institute of the University of Pennsylvania; Professor of Experimental Pathology in the University of Pennsylvania. Henry Phipps Institute. Seventh and Lombard Sts.

1904. LINDAUER, EUGENE, M.D., Instructor of Neurology in the Medico-Chirurgical Hospital; Associate in Clinical Medicine in the Philadelphia Polyclinic; Assistant Neurologist to the Philadelphia General Hospital. 2018 N. Thirty-second Street.

1886. LLOYD, J. HENDRIE, A.M. (Princeton), M.D., Neurologist to the Philadelphia General Hospital, and to the Methodist Episcopal Hospital; Consulting Neurologist to the State Asylum for the Chronic Insane at Wernersville, and to the Pennsylvania Training School for Feeble-minded Children at Elwyn. 4057 Spruce St.

1907. LODHOLZ, EDWARD, M.D., Demonstrator of Physiology in the University of Pennsylvania. 1106 S. 52d St.

1893. LONGAKER, DANIEL, M.D., Obstetrician to the Kensington Hospital for Women and Visiting Obstetrician to the Jewish Maternity Hospital. 1806 Spruce St.

1907. LOUX, HIRAM R., M.D., Professor of Genito-urinary Surgery in the Jefferson Medical College; Surgeon to the Philadelphia General Hospital. Medical Arts Building. Sixteenth and Walnut Sts.

1921. LUCKE, BALDWIN, Dr. P.H., M.D., Assistant Pathologist, University and Philadelphia General Hospitals. Assistant Professor of Pathology, Medical School, University of Pennsylvania; Medical School, University of Pennsylvania.

1919. LYNCH, FRANK B., JR., M.D., Pepper Laboratory, University of Pennsylvania.

1914. LYON, B. B. VINCENT, A.B. (Williams Coll.), M.D., (Johns Hopkins), Associate in Medicine Jefferson Medical College; Chief-of-Clinic, Gastro-Intestinal Department, Jefferson Hospital; Visiting Physician to Methodist Hospital. 2014 Walnut St.

ELECTED

1900. McCarthy, Daniel J., M.D., Professor of Medical Jurisprudence (George B. Wood Foundation) in the University of Pennsylvania; Neurologist to the Philadelphia General and St. Agnes' Hospitals, and to the Henry Phipps Institute. 2025 Walnut St.

*1903. McConnell, Guthrie, M.D., Pathologist to the Cleveland City Hospital; Associate in Pathology, Western Reserve Medical School. 2601 Hampshire Road, Cleveland, Ohio.

1913. McCrae, Thomas, B.A., M.D., F.R.C.P. (Lond.), Professor of Medicine in the Jefferson Medical College; Physician to the Jefferson and Pennsylvania Hospitals. 1929 Spruce Street.

1895. McFarland, Joseph, M.D., Sc.D., Professor of Pathology and Bacteriology in the Medical Department of the University of Pennsylvania; Pathologist to the Philadelphia General Hospital. 442 W. Stafford St., Germantown.

1913. McGlinn, John A., M.S., M.D., Associate Professor of Gynecology, Graduate School of Medicine, University of Pennsylvania; Gynecologist to St. Agnes' Hospital; Gynecologist, Philadelphia General Hospital. 113 S. Twentieth St.

1905. McKenzie, Robert Tait, A.B., M.D., Professor of Physical Education and Director of the Department of Physical Education in the University of Pennsylvania. 2014 Pine St.

1916. McKnight, Howard A., A.B., M.D., Assistant Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon, St. Mary's Hospital; Chief Surgical Clinic, Polyclinic and Medico-Chirurgical Hospitals. 241 S. Thirteenth St.

1915. McLean, John D., M.D. 1538 S. Broad St.

*1900. McReynolds, Robert Phillips, M.D. 213 S. Broadway, Los Angeles, Cal.

1886. MacCoy, Alexander W., M.D., Consulting Laryngologist to the Bryn Mawr Hospital. Haverford Court, Haverford, Pa.

1910. Mackinney, William H., M.D., Assistant Surgeon to the Dispensary for Genito-urinary Diseases, University Hospital; Assistant in the Urological Dispensary of the Lankenau Hospital. 1701 Chestnut St.

1914. Maier, F. Hurst, M.D., Associate in Gynecology to the Jefferson Medical College; Gynecologist to St. Joseph's Hospital. 2035 Chestnut St.

ELECTED

1913. Major, C. Percy, M.D., Physician to the Dispensary of the Germantown Hospital; Pediatrist to the Dispensary of the Germantown Hospital; Pediatrist to the Abington Memorial Hospital. Tenth and Oak Lane.

1913. Manges, Willis F., M.D., Roentgenologist to the Jefferson Hospital; Director of the Roentgen Ray Laboratory in the Philadelphia General Hospital. 235 S. Fifteenth St.

1898. Marshall, George Morley, M.D., Laryngologist to the Philadelphia General Hospital; Laryngologist and Otologist to St. Joseph's Hospital. 1819 Spruce St.

1889. Martin, Edward, M.D., Surgeon to the University, Howard, Philadelphia General, and Bryn Mawr Hospitals. 135 S. Eighteenth St.

*1911. Meigs, Edward Browning, A.B., M.D., Physiologist in the Dairy Division of the United States Department of Agriculture. 1445 Rhode Island Ave., N. W., Washington, D. C.

1914. Mencke, J. Bernhard, A.B., M.D., Assistant Surgeon to the Out-patient Department of the Lankenau Hospital; Assistant Surgeon to the Stetson Hospital. 1816 Spruce Street.

1914. Merrill, William Jackson, A.B., M.D., Professor of Orthopædic Surgery, Graduate School, University of Pennsylvania; Orthopædic Surgeon to the Children's Hospital, Germantown Hospital, Children's Seashore House; Consulting Orthopædic Surgeon to the Howard Hospital and Glen Mills School. 2017 Spruce St.

*1894. Miller, D. J. Milton, M.D., Associate Physician to the Children's Hospital, Philadelphia; Pediatrist to the Bamberger Home for Invalid Children, Longport, N. J. N. W. Cor. Pacific and California Aves., Atlantic City, N. J.

1910. Miller, Morris Booth, M.D., Professor of Surgery in the Philadelphia Polyclinic; Surgeon to the Douglass Memorial Hospital; Assistant Surgeon to the Philadelphia General Hospital. 409 S. Twenty-second St.

1921. Miller, T. Grier, A.B., M.D., Assistant Physician, University Hospital; Associate in Medicine, University of Pennsylvania. 110 S. Twentieth St.

1881. Mills, Charles K., M.D., LL.D., Emeritus Professor of Neurology in University of Pennsylvania; Neurologist to Philadelphia General Hospital; Consulting Physician to the Orthopædic Hospital and Infirmary for Nervous Diseases. 1909 Chestnut Street.

ELECTED

1917. MITCHELL, A. GRAEME, M.D., Associate in Pediatrics, University of Pennsylvania; Assistant Pediatrist, Presbyterian Hospital; Clinical Assistant, Children's Hospital of Philadelphia; Physician to Dispensary Children's Hospital of Philadelphia. 1725 Pine St.

1904. MITCHELL, CHARLES F., M.D., Surgeon to the Pennsylvania, Bryn Mawr, and Germantown Hospitals. 332 S. Fifteenth Street.

1921. MOHLER, HENRY K., P.D., M.D., Instructor in Medicine, Jefferson Medical College; Medical Director, Jefferson Hospital. 319 S. Sixteenth St.

*1908. MONTGOMERY, CHARLES M., A.B., M.D., U.S.P.H.S. Hospital, Oteen, N. C.

1882. MONTGOMERY, EDWARD E., A.M., M.D., LL.D., Gynecologist to the Jefferson Medical College Hospital and to St. Joseph's Hospital. 1426 Spruce St.

1918. MORGAN, ARTHUR C., M.D., Associate Professor in Medicine in the Medico-Chirurgical College, Graduate School of Medicine, University of Pennsyvlania; Visiting Physician to Tuberculosis Department, Philadelphia General Hospital; Physician-in-Chief to the Frankford Hospital. 3118 Diamond St.

1886. MORRIS, CASPAR, M.D. 2050 Locust St.

1893. MORRIS, ELLISTON J., M.D., Physician to the Episcopal Hospital. 128 S. Eighteenth St.

1883. MORRIS, HENRY, M.D., Professor of Anatomy in the Woman's Medical College of Pennsylvania; Senior Visiting Physician to St. Joseph's Hospital. 313 S. Sixteenth St.

°1856. MORRIS, J. CHESTON, M.D. "Fernbank," West Chester, Pa.

1906. MORRISON, WILLIAM H., M.D. 8021 Frankford Ave.

1897. MORTON, SAMUEL W., M.D. 1926 Chestnut St.

1905. MÜLLER, GEORGE P., M.D., Professor of Surgery in the Graduate School of the University of Pennsylvania; Associate in Surgery in the Medical School of the University of Pennsylvania; Surgeon to the Misericordia and St. Agnes' Hospitals; Consulting Surgeon to the Chester County Hospital. 1930 Spruce St.

1915. MUSSER, JOHN H., JR., B.S., M.D., Assistant Professor in Medicine in the University of Pennsylvania; Physician to the Philadelphia General Hospital; Physician-in-Charge, Medical Dispensary, University Hospital; Dispensary Chief and Assistant Physician in the Presbyterian Hospital. 262 S. Twenty-first St.

ELECTED

1905. Mutschler, Louis H., M.D., Surgeon to the Episcopal Hospital; Assistant Surgeon to the Orthopædic Hospital. 1625 Spruce St.

*1896. Myers, T. D., M.D. P. O. Box 314, Pasadena, Cal.

1902. Nassau, Charles F., M.D., LL.D., Assistant Professor of Surgery in the Jefferson Medical College; Surgeon to St. Joseph's Hospital; Chief Surgeon to the Frankford Hospital; Surgeon to Mount Sinai Hospital. 1710 Locust St.

1886. Neff, Joseph S., A.M., M.D., LL.D., D.P.H., Narberth, Pa.

1887. Neilson, Thomas Rundle, A.M., M.D., Surgeon to the Episcopal Hospital and to St. Christopher's Hospital for Children; Professor of Genito-urinary Surgery in the University of Pennsylvania. 1937 Chestnut St.

1905. Newcomet, William S., M.D. 3501 Baring St.

1905. Newlin, Arthur, B.S., M.D., Physician to the Pennsylvania Hospital; Physician to the Dispensary of the Children's Hospital; Assistant Physician to the Orthopædic Hospital. 1804 Pine St.

1899. Nicholson, William Rufus, A.B., M.D., Gynecologist to the Polyclinic and Methodist Episcopal Hospitals; Obstetrician to the Presbyterian Hospital; Professor of Gynecology, Graduate School, University of Pennsylvania; Associate in Obstetrics in the University of Pennsyvlania. 2023 Spruce St.

1889. Noble, Charles P., M.D. 1832 Spruce St.

1905. Norris, Charles C., M.D., Associate in Gynecology, University of Pennsylvania Medical School; Assistant Professor, Graduate School of Medicine, University of Pennsylvania; Assistant Gynecologist to the Hospital of the University of Pennsylvania; Gynecologist to the Children's Hospital, Philadelphia. Coronado, 22d and Chestnut Sts.

1905. Norris, George William, A.B., M.D., Professor of Clinical Medicine in the University of Pennsylvania; Physician to the Pennsylvania Hospital. 1820 S. Rittenhouse Sq.

*1901. Norris, Henry, M.D., Surgeon to the Rutherford Hospital. Rutherfordton, N. C.

1892. Norris, Richard C., M.D., Lecturer on Clinical and Operative Obstetrics in the University of Pennsylvania; Obstetrician in Charge of the Preston Retreat; Visiting Obstetrician to the Philadelphia General Hospital; Gynecologist to the Methodist Episcopal Hospital, and Consulting Obstetrician

ELECTED

and Attending Gynecologist to the Southeastern Dispensary and Hospital. 500 N. Twentieth St.

1913. O'Neal, Alexander H., A.B., A.M., M.D., Physician to the Cathcart and Richardson Homes, Devon; Anesthetizer to the Bryn Mawr Hospital. St. Davids, Pa.

1920. Ostheimer, Alfred J., A.B., M.D., L.R.C.P. (London), M.R.C.S. (England), Neurologist to Abington Memorial Hospital; Chief, Neuro-psychiatric Section, District No. 3, United States Veteran's Bureau. Jenkintown, Pa.

1903. Ostheimer, Maurice, A.B., M.D., Associate in Pediatrics in the University of Pennsylvania; Visiting Physician to the Philadelphia Hospital for Contagious Diseases; Physician-in-Charge of the Children's Dispensary and Assistant Visiting Pediatric Physician, University Hospital; Physician to the Medical Dispensary of the Children's Hospital. 2204 De Lancey Place.

1913. Outerbridge, George W., A.B., M.D., Associate Professor of Gynecology, Graduate School of Medicine of the University of Pennsylvania; Assistant Gynecologist to the Methodist Hospital; Gynecologist to the Abington Memorial Hospital. 2039 Chestnut St.

1915. Owen, Hubley R., M.D., Surgeon to the Philadelphia General Hospital; Assistant Surgeon to the Orthopædic Hospital; Chief Surgeon of the Bureaus of Police and Fire, Philadelphia. 319 S. Sixteenth St.

1897. Packard, Francis R., M.D., Laryngologist and Aurist to the Pennsylvania Hospital; Professor of Otology, Graduate School, University of Pennsylvania; Laryngologist to the Children's Hospital; Consulting Laryngologist and Otologist to the Bryn Mawr Hospital. 304 S. Nineteenth St.

1898. Page, Henry F., M.D., Assistant Physician to the Lankenau Hospital and Physician to the Medical Dispensary of the same; Clinical Professor of Medicine in the Woman's Medical College of Pennsylvania. 315 S. Sixteenth St.

1906. Pancoast, Henry K., M.D., Professor of Röntgenology in the University of Pennsylvania and Röntgenologist to the University Hospital. Ardmore, Pa.

1909. Parish, Benjamin D., B.S., M.D., Assistant Instructor in Otology in the University of Pennsylvania; Assistant Surgeon to the Dispensary for Diseases of the Ear, Uni-

ELECTED

versity Hospital; Aurist and Laryngologist to St. Agnes' Hospital. 2039 Chestnut St.

1899. PARKE, WILLIAM E., M.D., Consulting Obstetrician to the Episcopal Hospital; Associate Surgeon to the Kensington Hospital for Women; Gynecologist to the Frankford Hospital. 1739 N. Seventeenth St.

1910. PATTERSON, ROSS VERNET, M.D., Dean, Jefferson Medical College; Associate Professor of Medicine in the Jefferson Medical College; Physician to the Philadelphia Hospital; Assistant Physician to the Jefferson Hospital. 2126 Spruce Street.

1903. PEARCE, Richard M., M.D., Sc.D., Director of Division of Medical Education, Rockefeller Foundation. 61 Broadway, New York, N. Y. 2114 De Lancey Place.

1909. PEMBERTON, RALPH, M.S., M.D., Visiting Physician to the Presbyterian Hospital; Director of the Department of Clinical Chemistry in the Pathological Laboratory of the Presbyterian Hospital. 318 S. Twenty-first St.

†1889. PENROSE, CHARLES BINGHAM, M.D., Ph.D. (Harvard), Formerly Professor of Gynecology in the University of Pennsylvania. 1720 Spruce St.

1914. PEPPER, O. H. PERRY, B.S., M.D., Assistant Professor of Medicine, University of Pennsylvania. Medical Arts Bldg.

†1902. PEPPER, WILLIAM, A.B., M.D., Dean of the School of Medicine, University of Pennsylvania; President Association of American Medical Colleges. 1813 Spruce St.

1916. PERCIVAL, MILTON FRASER, M.D. 2332 S. Broad St.

1917. PETER, LUTHER C., A.M., M.D., Professor of Diseases of the Eye, Temple Medical School; Professor of Ophthalmology, University of Pennsylvania Graduate School. 1529 Spruce St.

1912. PETTY, ORLANDO H., B.S., A.M., M.D., Instructor in Medicine in the Jefferson Medical College; Pathologist and Assistant Physician to St. Timothy's Hospital; Physician to the Kensington Dispensary for the Treatment of Tuberculosis. 6215 Ridge Ave.

1905. PFAHLER, GEORGE E., M.D., Professor of Roentgenology in the Medico-Chirurgical Graduate School of Medicine of the University of Pennsylvania; Director of the X-ray Laboratories at the Howard Hospital, Polyclinic Hospital and the Misericordia Hospital; Honorary member, Scandinavian Radiological Society. 1321 Spruce St.

ELECTED

1915. PFEIFFER, DAMON B., A.B., M.D., Instructor in Surgery, University of Pennsylvania; Assistant Surgeon, University Hospital; Pathologist to the Lankenau Hospital; Assistant Surgeon, Presbyterian Hospital. 2028 Pine St.

1907. PFROMM, GEORGE W., Ph.G., M.D., Assistant Physician to the American Stomach Hospital; Consulting Physician to the German Protestant Home for the Aged. 1431 N. Fifteenth St.

1907. PHILLIPS, HORACE, M.D., Examining Psychiatrist, Philadelphia Hospital and Office of the District Attorney. 905 Land Title Building.

1883. PIERSOL, GEORGE A., M.D., Sc.D., Emeritus Professor of Anatomy in the University of Pennsylvania. 4724 Chester Ave.

1911. PIERSOL, GEORGE MORRIS, B.S., M.D., Professor of Medicine in the Graduate School of Medicine of the University of Pennsylvania; Professor of Medicine in the Woman's Medical College of Pennsylvania; Physician to the Philadelphia General Hospital. 1913 Spruce St.

1917. PIPER, EDMUND BROWN, B.S., M.D., Associate in Obstetrics, University of Pennsylvania Medical School; Assistant Professor in Obstetrics, University of Pennsylvania Graduate School; Assistant Obstetrician to the University Hospital; Assistant Obstetrician and Gynecologist to the Philadelphia General Hospital. 1936 Spruce St.

1905. PITFIELD, ROBERT L., M.D., Pathologist to the Germantown Hospital; Bacteriologist to the Chestnut Hill Hospital for Lung Diseases. 5211 Wayne Ave.

1896. POSEY, WILLIAM CAMPBELL, M.D., Ophthalmic Surgeon to the Howard Hospital; Consulting Ophthalmic Surgeon to the Wills Eye Hospital; Chairman of the Commission on the Conservation of Vision for Pennsylvania. 2049 Chestnut Street.

1899. POTTS, CHARLES S., M.D., Professor of Neurology, Graduate School, University of Pennsylvania; Neurologist to the Philadelphia General Hospital; Consulting Neurologist, Lankenau Hospital; Consulting Neurologist, Hospital for the Insane, Atlantic County, New Jersey, 2018 Chestnut St.

*1907. PRICE, GEORGE E., M.D. Suite 620, Paulsen Bldg., Spokane, Wash.

1920. QUICKSALL, WILLIAM E., M.D. 1819 Spruce St.

ELECTED

1908. Radcliffe, McCluney, A.M. (Lafayette), M.D., LL.D., Consulting Ophthalmologist, Presbyterian Hospital; attending Surgeon to the Wills Eye Hospital. 1906 Chestnut St.

1913. Randall, Alexander, A.M., M.D., Assistant Instructor in Surgery in the University of Pennsylvania; Assistant Surgeon in the Genito-Urinary Dispensary of the University of Pennsylvania. 1310 Medical Arts Building.

1887. Randall, B. Alexander, M.A., M.D., Professor of Otology in the University of Pennsylvania; Ear Surgeon to the Children's Hospital; Consulting Aurist to the Pennsylvania Institution for the Deaf and Dumb, and to St. Timothy's Hospital. 1717 Locust St.

*1904. Ravenel, Mazyck P., M.D., Professor of Preventive Medicine and Bacteriology and Director of the Public Health Laboratory at the University of Missouri. 203 Hicks Ave., Columbia, Mo.

1920. Rehfuss, Martin E., M.D. N. E. Cor. 16th and Spruce Sts.

1921. Reiff, E. Paul, A.B., M.D., Member of Medical Staff, Methodist Episcopal Hospital. 5051 Chestnut St.

1919. Reiman, Stanley P., M.D. 516 Arbutus St., Gtn.

1897. Rhein, John H. W., M.D., Professor of Nervous Diseases, Graduate School of Medicine, University of Pennsylvania; Neuropsychiatrist to the Philadelphia General Hospital; Consulting Neurologist to the Philadelphia Home for Incurables. 1732 Pine St.

1906. Rhein, Robert D., M.D., Chief Physician to the Clinic of the American Hospital for Diseases of the Stomach; Physician to the Philadelphia Home for Incurables; Examining Physician to the White Haven Sanatorium. S. W. Cor. 15th and Pine Sts.

1891. Rhoads, Edward G. M.D., 108 Queen Lane, Germantown.

*1910. Rhoads, Samuel, M.D. Pasadena, California.

1919. Richardson, Russell, A.M., M.D., Director of the Laboratory, Methodist Episcopal Hospital; Pathologist to Abington Memorial and Chestnut Hill Hospitals. 320 S. Sixteenth St.

1919. Ridpath, Robert F., M.D. 1928 Chestnut St.

1898. Riesman, David, M.D., Professor of Clinical Medicine in the University of Pennsylvania; Physician to the Philadelphia General and University Hospitals; Consulting Physician to the Jewish Hospital. 1715 Spruce St.

ELECTED

1895. Ring, G. Oram, A.M., M.D., Orphthalmic Surgeon to the Episcopal Hospital; Ophthalmologist to the Widener Memorial Home for Crippled Children; Consulting Ophthalmologist to the American Oncologic Hospital. N. E. Cor. Seventeenth and Walnut Sts.

*1905. Risley, J. Norman, M.D. New Bedford, Mass.

†1878. Roberts, John B., A.M., M.D., Professor of Surgery in the University of Pennsylvania Graduate School of Medicine. 313 S. Seventeenth St.

1899. Roberts, Walter, M.D., Professor of Otology in the Philadelphia Polyclinic; Otologist to the Methodist Episcopal Hospital; Laryngologist to the Philadelphia General Hospital. 1732 Spruce St.

1903. Robertson, William Egbert, M.D., Professor of Theory and Practice of Medicine and of Clinical Medicine in Temple University; Physician to the Episcopal, Samaritan, and Garretson Hospitals. 327 S. Seventeenth St.

1902. Robinson, James Weir, M.D. 326 S. Sixteenth St.

1903. Robinson, William Duffield, Ph.G., M.D. 2012 Mount Vernon St.

1912. Rodman, John Stewart, M.D., Lecturer on Surgery in the Medico-Chirurgical College; Assistant Surgeon to the Medico-Chirurgical Hospital; Assistant Surgeon to the Presbyterian Hospital; Assistant Surgeon to the Outpatient Department of the Pennsylvania Hospital. 1310 Medical Arts Building.

1909. Rosenberger, Randle C., M.D., Professor of Hygiene and Bacteriology in the Jefferson Medical College. 2330 N. Thirteenth St.

1898. Ross, George G., M.D., Visiting Surgeon, Germantown, Stetson and Methodist Hospitals; Assistant Surgeon, Lankenau Hospital; Assistant Surgeon, Hospital of the University of Pennsylvania; Associate in Surgery, University of Pennsylvania School of Medicine. 1721 Spruce St.

*1907. Royer, B. Franklin, M.D., Mass.-Halifax Health Commission Halifax, Nova Scotia.

†1905. Rugh, James Torrance, A.B., M.D., Clinical Professor of Orthopedic Surgery in the Woman's Medical College of Pennsylvania; Orthopedic Surgeon to the Jefferson Medical College; Orthopedic Surgeon to the Methodist and the Philadelphia General Hospitals. 1616 Spruce St.

ELECTED

1897. Sailer, Joseph, Ph.B., M.D., Professor of Clinical Medicine in University of Pennsylvania; Physician to the Philadelphia General, the University, and Presbyterian Hospitals. 1718 Spruce St.

1900. Sajous, Charles E. de M., M.D., LL.D., ScD., Knight of the Legion of Honor of France; and of the Order of Leopold of Belgium; Professor of Therapeutics in Temple University Medical School. 2043 Walnut St.

1905. Sartain, Paul J., A.M., M.D. 2006 Walnut St.

1908. Sautter, Albert C., M.D., Assistant in the Dispensary for Diseases of the Eye in the University Hospital; Assistant in the Eye Dispensary of the Lankenau Hospital, 1421 Locust St.

1906. Saylor, Edwin S., M.D., Chief Ophthalmic Surgeon to the Charity Hospital of Philadelphia, and to the Department Eye and Ear, American Hospital for Diseases of the Stomach. 2005 Chestnut St.

1920. Scarlett, Hunter W., M.D. 2228 Locust St.

*1910. Scarlett, Rufus B., M.D., Laryngologist to the Home for Consumptives at Chestnut Hill; Assistant in the Department for Diseases of the Ear, Throat, and Nose of the Pennsylvania Hospital; Instructor in Diseases of the Nose and Throat in the Philadelphia Polyclinic and College for Graduates in Medicine. 78 N. Clinton Ave., Trenton, N. J.

1917. Schaeffer, Jacob Parsons, A.M., M.D., Ph.D., Professor of General Anatomy and Director of the Daniel Baugh Institute of Anatomy of the Jefferson Medical College. 4634 Spruce St.

1899. Schamberg, Jay F., M.D., Professor of Dermatology and Infectious Eruptive Diseases, Graduate School, University of Pennsylvania. 1922 Spruce St.

1917. Schnabel, Truman Gross, A.B. (Lehigh), M.D., Instructor in Medicine, University of Pennsylvania; Assistant Physician, Philadelphia General Hospital; Physician in the Medical Out-patient Department, University Hospital. 1704 Pine Street.

1917. Schoff, Charles H., M.D. Media, Pa.

1921. Schumann, Edward Armin, A.B., M.D., Obstetrician and Gynecologist, Philadelphia General Hospital; Gynecologist, Frankford Hospital; Lecturer on Obstetrics, Jefferson Medical College; Consulting Gynecologist, Rush Hospital 124 S. Eighteenth St.

ELECTED

1887. DE SCHWEINITZ, GEORGE EDMUND, A.M., M.D., LL.D., Professor of Ophthalmology in the University of Pennsylvania; Consulting Ophthalmic Surgeon to the Orthopædic Hospital and Infirmary for Nervous Diseases; The Philadelphia Polyclinic and School for Graduates in Medicine, and the Philadelphia General Hospital; Ophthalmic Surgeon to the University Hospital. 1705 Walnut St.

*1913. DE SCHWEINITZ, GEORGE LORD, B.S., M.D., Assistant in the Department of Ophthalmology, St. Luke's Hospital, Bethlehem, Pa. 85 East Broad St., Bethlehem, Pa.

1910. SCHWENK, PETER N. K., M.A., M.D., Attending Surgeon to the Eye Department of the Pennsylvania Hospital; Attending Surgeon to the Wills Eye Hospital. 1417 N. Broad Street.

1892. SEISS, RALPH W., M.D., Professor of Otology in the Philadelphia Polyclinic; Consulting Laryngologist to the Pennsylvania Institution for the Deaf and Dumb. 255 S. Seventeenth St.

1917. SERVICE, CHARLES A., M.D. Bala, Pa.

1908. SHANNON, CHARLES E. G., A.B., M.D., Instructor in Ophthalmology in the Jefferson Medical College; Assistant in the Ophthalmological Clinic at the Jefferson Medical College Hospital; Ophthalmologist to the Seybert Institution. 1633 Spruce St.

1897. SHARPLESS, WILLIAM T., M.D., Physician to the Chester County Hospital. West Chester, Pa.

1906. SHIELDS, WILLIAM G., M.D., Dermatologist to Germantown Hospital; Chief of Dermatological Clinic and Assistant Physician to the Jewish Hospital. 414 School Lane, Germantown.

1890. SHOEMAKER, GEORGE ERETY, A.M., M.D., Gynecologist to the Presbyterian Hospital and to the Pennsylvania Epileptic Hospital and Colony Farm; Consulting Surgeon Woman's Hospital. 1906 Chestnut St.

*1908. SHOEMAKER, HARLAN, A.B., M.D., Lecturer in Surgery, University of Southern California; Surgeon to Los Angeles County Hospital; Surgeon to Washington Street Clinic. 621 March Strong Building, Los Angeles, Cal.

†1893. SHOEMAKER, HARVEY, M.D., Visiting Physician to the Sheltering Arms; Consulting Physician to the Southern Home for Destitute Children; Assistant Physician to the Lankenau Hospital; Physician to the Out-patient Department of the Lankenau Hospital. N. W. Cor. 20th and Chestnut Sts.

ELECTED

†1896. Shoemaker, William T., M.D., Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Clinical Professor of Ophthalmology in the Woman's Medical College of Pennsylvania; Ophthalmic Surgeon to Lankenau, Germantown and Pennsylvania Hospitals. 109 S. Twentieth St.

1900. Shumway, Edward Adams, B.S., M.D., Ophthalmic Surgeon to the Philadelphia General, Lankenau and Children's Hospitals; Assistant Professor of Ophthalmology in the University of Pennsylvania, and Assistant Ophthalmic Surgeon to the University Hospital. 2046 Chestnut St.

1903. Sinclair, John Falconer, M.D., Epidemilogist, Presbyterian Hospital; Physician to the Philadelphia Orphan Asylum and to the Presbyterian Orphanage; Physician to the Home of the Merciful Saviour for Crippled Children. 4103 Walnut St.

1907. Sinkler, Francis Wharton, A.B., M.D., Physician to the Orthopædic Hospital and Infirmary for Nervous Diseases; Physician to the Episcopal Hospital. 1606 Walnut St.

1902. Siter, E. Hollingsworth, M.D., Associate in Genito-urinary Surgeon in the University of Pennsylvania; Genito-urinary Surgery to the Philadelphia General Hospital; Surgeon-in-Charge of the Genito-urinary Dispensary of the University Hospital; Consulting Genito-urinary Surgeon to the Eastern Penitentiary and to the Philadelphia County Prison. 1520 Locust St.

1904. Skillern, Penn-Gaskell, M.D. 241 S. Thirteenth St.

1920. Skillern, Ross Hall, M.D., Professor of Laryngology, Graduate School, University of Pennsylvania; Laryngologist to Medico-Chirurgical Hospital. 1928 Chestnut St.

1904. Smith, Allen J., A.M., M.D., Sc.D. (Penna. Coll.), LL.D. (McGill Univ.), Professor of Pathology and of Comparative Pathology, and Director of Courses in Tropical Medicine in the University of Pennsylvania. Medical Laboratories, University of Pennsylvania.

1905. Smith, S. MacCuen, M.D., Professor of Otology in the Jefferson Medical College; Aurist and Laryngologist to the Germantown Hospital; Aurist to the Jewish Hospital; Consulting Aurist to the Memorial Hospital, Roxborough; Consulting Aurist to the Oncologic Hospital. 1429 Spruce St.

ELECTED

1919. Smyth, Henry Field, M.D. Wayne, Pa.

1908. Speese, John, M.D., Assistant Professor Surgical Pathology, University of Pennsylvania; Associate Professor in Surgery, Graduate School, University of Pennsylvania; Surgeon to the Children's and Presbyterian Hospitals. 2032 Locust St.

1895. Spellissy, Joseph M., A.M., M.D., Visiting Surgeon to St. Joseph's and to the Methodist Episcopal Hospitals; Assistant Surgeon to the Orthopedic Department of the University Hospital. 317 S. Fifteenth St.

1897. Spiller, William G., M.D., Professor of Neurology in the University of Pennsylvania; Clinical Professor of Nervous Diseases in the Woman's Medical College of Pennsylvania; Neurologist to the Philadelphia General Hospital; Consultant Neurologist to the Pennsylvania Hospital. 4409 Pine St.

1894. Stahl, B. Franklin, B.S., Ph.G., M.D., Clinical Professor of Medicine in the Woman's Medical College of Pennsylvania; Associate in Medicine and Lecturer on Dietetics of the Sick in the University of Pennsylvania; Visiting Physician to St. Agnes' and the Philadelphia General Hospitals. 1727 Pine St.

1909. Starbuck, J. Clinton, M.D., Physician to the Orphanage, Orphan Society of Philadelphia at Wallingford and to the Glen Mills School, Glen Mills, Pa. 42 E. Washington St., Media, Pa.

*1875. Starr, Louis, M.D., LL.D. (Haverford). Care of Brown, Shipley & Co., London, England.

1912. Stauffer, Nathan Pennypacker, D.D.S., M.D., Laryngologist and Otologist to the Presbyterian Hospital; to the Philadelphia General Hospital, Tubercular Department; to the Home for Crippled Children. 1819 Walnut St.

1910. Stellwagen, Thomas C., Jr., M.D., Chief Clinical Assistant in the Out-patient Surgical Department of the Jefferson Medical College Hospital. 1912 Pine St.

1895. Stengel, Alfred, M.D., Sc.D., Professor of Medicine in the University of Pennsylvania; Physician to the University Hospital and the Pennsylvania Hospital. 1728 Spruce Street.

1901. Stevens, Arthur A., M.D., Professor of Materia Medica, Therapeutics, and Clinical Medicine in the Woman's Medical College of Pennsylvania; Lecturer on Physical

ELECTED

Diagnosis in the University of Pennsylvania; Physician to the Episcopal and St. Agnes' Hospitals. 314 S. Sixteenth Street.

1914. STEWART, THOMAS S., B.S. (Univ. of Penna.), M.D. 301 S. Eighteenth St.

1921. STONER, WILLIAM H., A.B., A.M., Ph.C., Pharm. D., M.D., Biochemist, Philadelphia Hospital; Associate Professor of Biochemistry, Graduate School of Medicine, University of Pennsylvania. Medical Laboratories, University of Pennsylvania.

1898. STOUT, GEORGE C., M.D., Professor of Otology in the Philadelphia Polyclinic and College for Graduates in Medicine; Consulting Laryngologist and Aurist to the Presbyterian Hospital, the Children's Aid Society, and the William Penn Charter School. 1611 Walnut St.

1884. STRYKER, SAMUEL S., M.D., Consulting Physician to the Presbyterian Hospital. 3833 Walnut St.

*1900. SWAN, JOHN M., M.D. 457 Park Avenue, Rochester, New York.

1898. SWEET, WILLIAM M., M.D., Clinical Professor of Ophthalmology in the Jefferson Medical College, and Ophthalmic Surgeon to the Jefferson Medical College Hospital; Consulting Surgeon to the Wills Eye Hospital. 1205 Spruce St.

1900. TALLEY, JAMES ELY, A.B., M.D., Professor of Cardiology, Graduate School, University of Pennsylvania; Physician to the Presbyterian and Methodist Episcopal Hospitals. 218 S. Twentieth St.

1911. TAYLOR, ALONZO ENGLEBERT, M.D., Rush Professor of Physiological Chemistry in the University of Pennsylvania. 4522 Locust St.

1886. TAYLOR, JOHN MADISON, A.B. and A.M. (Princeton), M.D., Professor of Physical Therapeutics and Diatetics, Medical Department Temple University. 1504 Pine St.

1887. TAYLOR, WILLIAM J., M.D., Surgeon to the Orthopædic Hospital and Infirmary for Nervous Diseases, and to St. Agnes' Hospital; Consulting Surgeon to the West Philadelphia Hospital for Women. 1825 Pine St.

1886. TAYLOR, WILLIAM L., M.D. 1340 N. Twelfth St.

†1910. THOMAS, BENJAMIN A., A.B., A.M., M.D., Professor of Genito-urinary Surgery in the Philadelphia Polyclinic and College

ELECTED

for Graduates in Medicine; Genito-urinary Surgeon, Presbyterian Hospital; Instructor in Surgery in the University of Pennsylvania; Surgeon-in-Chief, Genito-urinary Department of the Out-patient Department of the University Hospital. 116 S. Nineteenth St.

1912. THOMAS, FRANK WISTER, A.M., M.D., Visiting Physician to "Buttercup Cottage;" Consulting Physician to the Germantown Hospital. 27 E. Mt. AiryAve.

1907. THOMAS, THOMAS TURNER, M.D., Associate Professor of Applied Anatomy, and Associate in Surgery in the University of Pennsylvania; Surgeon to the Philadelphia General Hospital; Assistant Surgeon to the University Hospital. 1905 Chestnut St.

1896. THORINGTON, JAMES, A.M., M.D., Emeritus Professor of Diseases of the Eye in the Philadelphia Polyclinic and College for Graduates in Medicine; Ophthalmic Surgeon to the Presbyterian Hospital; Ophthalmologist to the Ellwyn, Pa., Training School for Feeble-minded Children. 2031 Chestnut St.

1898. THORNTON, EDWARD Q., M.D., Assistant Professor of Materia Medica in the Jefferson Medical College. 1331 Pine St.

1912. TORREY, ROBERT G., M.D., Assistant Physician to the Philadelphia General Hospital; Physician to the State Tuberculosis Dispensary. 1716 Locust St.

1896. TOULMIN, HARRY, M.D. Haverford, Pa.

1908. TRACY, STEPHEN E., M.D., Gynecologist to the Stetson Hospital; Visiting Surgeon to the Gynecean Hospital. 1527 Spruce St.

1901. TUCKER, HENRY, M.D., Genito-urinary Surgeon to the Philadelphia General Hospital; Curator of the Academy of Natural Sciences of Philadelphia. 1818 Pine St.

†1894. TUNIS, JOSEPH PRICE, M.D. 2216 De Lancey St.

1901. TURNER, JOHN B., M.D., Ph.D., Assistant in the Ophthalmological Clinic, Methodist Episcopal Hospital. 1833 Chestnut St.

1897. TYSON, T. MELLOR, M.D., Physician to the Philadelphia General Hospital; Physician to the Rush Hospital, the Philadelphia Lying-in-Charity Hospital, and the Children's Aid Society of Philadelphia. 1506 Spruce St.

1907. ULLOM, JOSEPHUS TUCKER, M.A., M.D., Member of the Staff of the Henry Phipps Institute; Visiting Physician to the Chestnut Hill Hospital. 24 Carpenter St., Germantown.

ELECTED

*1913. Vail, William Penn, B.S., M.S., M.D., Laryngologist to the Pennsylvania Institution for the Instruction of the Blind; Laryngologist to the Department for Tuberculosis of the Philadelphia General Hospital; Assistant Laryngologist and Otologist to the Out-patient Department of the Pennsylvania Hospital; Assistant Laryngologist to the Children's Hospital. Blairstown, N. J.

?1873. Van Harlingen, Arthur, Ph.B. (Yale), M.D., Emeritus Professor of Diseases of the Skin in the Philadelphia Polyclinic. 1831 Chestnut St.

1903. Van Pelt, William Turner, M.D. 1100 Widener Building.

1893. Vansant, Eugene Larue, M.D. 2046 Chestnut St.

1912. Vaux, Norris Wistar, M.D., Surgeon to the Chestnut Hill Hospital; Surgeon to the Dispensary of the Germantown Hospital. 1807 Walnut St.

*1897. Veasey, Clarence A., A.M., M.D. Suite 404, Paulsen Building, Spokane, Wash.

†1883. Vinton, Charles Harrod, A.M., M.D. P. O. Box 464, Atlantic City, N. J.

1903. Wadsworth, William Scott, M.D. 3914 Baltimore Ave.

1906. Walker, John K., M.D., Physician to the Children's Hospital of the Mary J. Drexel Home; Physician to the Out-patient Department of the Pennsylvania Hospital. 2038 Locust St.

1907. Walker, Warren, M.D., Dermatologist to the Episcopal and Howard Hospitals; Assistant Dermatologist to the Pennsylvania Hospital. 206 Church Road, Ardmore, Pa.

1904. Walsh, Joseph, A.M., M.D., Visiting Physician to and Medical Director of the White Haven Sanatorium; Medical Director of St. Agnes' Hospital. 2026 Chestnut St.

1910. Ward, E. Tillson, A.M., M.D. 2006 Mt. Vernon St.

1895. Watson, Arthur W., M.D., Professor of Diseases of the Throat and Nose in the Philadelphia Polyclinic and College for Graduates in Medicine; Laryngologist to the Jewish Hospital; Laryngologist and Aurist to the Mt. Sinai Hospital; Laryngologist to Home for Incurables. 128 S. Eighteenth Street.

1886. Watson, Edward W., M.D., Physician to the Magdalene Home. 38 S. Nineteenth St.

1903. Weber, Charles H., M.D., Physician to the Dispensary of the Children's Hospital. 1736 Pine St.

ELECTED

1920. WEIDMAN, FRED. D., M.D., Assistant Director, Laboratory of Dermatological Research, University of Pennsylvania; Assistant Pathologist, Philadelphia Zoölogical Garden and University Hospital. 20 Tenby Road, Llanerch, Pa.

1906. WEISENBURG, THEODORE H., M.D., Professor of Neurology, Graduate School, University of Pennsylvania; Consulting Neurologist to the State Hospital for the Insane at Norristown and to the State Hospital for the Feeble-minded and Epileptic at Spring City. 1909 Chestnut St.

1913. WELLS, P. FRAILEY, A.M., M.D., Ph.D 754 N. Fortieth St.

1893. WESTCOTT, THOMPSON S., M.D., Associate in Diseases of Children in the University of Pennsylvania; Pediatrist to the Methodist Episcopal Hospital; Consulting Physician, Haddock Memorial Home. 1720 Pine St.

1884. WHARTON, HENRY R., M.D., Consulting Surgeon to the Presbyterian and the Children's Hospitals; Surgeon to Girard College; Consulting Surgeon to the Bryn Mawr Hospital, the Chestnut Hill Hospital, St. Christopher's Hospital for Children, the Pennsylvania Institution for the Deaf and Dumb, and the Pennsylvania Institution for the Blind. 1725 Spruce St.

1921. WHITAKER, WILLIAM, M.D., Surgeon to Dispensary of the Episcopal Hospital. 5448 Germantown Ave.

1901. WHITE, COURTLAND Y., M.D., Director of the Pathological Laboratories of the Episcopal Hospital; Pathologist to the Children's Hospital and to the Kensington Hospital for Women; Chief Bacteriologist to the Bureau of Health, Department of Health and Charities, Philadelphia. 6611 N. Tenth St.

*1905. WHITEWAY, HAROLD M., M.D. 2356 W. Twenty-first St., Los Angeles, Cal.

1898. WHITING, ALBERT D., M.D., Surgeon to the Germantown Hospital; Assistant Surgeon to the Lankenau Hospital; Assistant Surgeon to the University Hospital; Instructor in Surgery in the University of Pennsylvania. 1523 Spruce Street.

1914. WILLARD, DE FOREST P., B.S. (Univ. of Penna.), M.D., Professor of Orthopædics, Graduate Medical School, University of Pennsylvania; Clinical Professor of Orthopædic Surgery, Woman's Medical College, Orthopædic Surgeon to the Polyclinic, Jewish and Delaware Hospitals. 1630 Spruce St.

ELECTED

1907. Williams, Carl, B.S., M.D., Ophthalmic Surgeon to the Germantown Hospital; Instructor in Ophthalmology in the University of Pennsylvania; Ophthalmic Surgeon to the Pennsylvania Institution for the Deaf and Dumb. School Lane and Greene Sts., Germantown.

1920. Williams, Philip F., Ph.B., M.D., Assistant Professor of Obstetrics, Graduate School of Medicine, University of Pennsylvania; Instructor in Obstetrics, School of Medicine, University of Pennsylvania; Obstetrician to the Maternity Hospital of Philadelphia and Assistant Gynecologist to the Presbyterian Hospital. 262 S. Twenty-first St.

1916. Wilmer, Harry B., M.D., Assistant Instructor in Medicine, University of Pennsylvania; Assistant Visiting Physician and Assistant Neurologist to the Germantown Hospital; Visiting Chief to the Dispensary of the Germantown Hospital. 138 W. Walnut Lane, Germantown.

1921. Wilson, George, M.D., Instructor in Medicine and Neurology, School of Medicine, University of Pennsylvania; Assistant Physician, Philadelphia Hospital; Assistant Neurologist, Philadelphia, University and Children's Hospitals; Consulting Neurologist, St. Christopher's Hospital and the Pennsylvania Training School for Feeble-minded Children. 5000 Walnut St.

1874. Wilson, James Cornelius, A.M. (Princeton), M.D., Emeritus Professor of the Practice of Medicine and of Clinical Medicine in the Jefferson Medical College; Physician-in-Chief to the Lankenau Hospital; Emeritus Physician to the Pennsylvania Hospital; Consulting Physician to the Bryn Mawr Hospital. 1509 Walnut St.

1902. Wilson, Samuel M., M.D. 2007 Chestnut St.

1897. Wilson, W. Reynolds, M.D. 1709 Spruce St.

1904. Wister, James W., M.D., Physician to the Out-patient Department of the Germantown Hospital. 5430 Germantown Ave.

*1901. Witmer, A. Ferree, M.D. Freeport, Long Island, N. Y.

1918. Wolferth, Charles Christian, A.B., M.D., Associate in Medicine, University of Pennsylvania; Associate in Cardiac Pathology, William Pepper Laboratory of Clinical Medicine, University of Pennsylvania. 1704 Pine St.

1893. Wood, Alfred C., M.D., Assistant Professor of Surgery in the University of Pennsylvania; Surgeon to the University, the Philadelphia General, St. Timothy's, and the Howard Hospitals. 2035 Walnut St.

ELECTED

1900. Wood, George, B., M.D., Laryngologist and Otologist, Orthopædic and Howard Hospitals; Professor of Laryngology, Graduate School, University of Pennsylvania. 1830 Spruce St.

1903. Wood, Horatio C., Jr., M.D., Professor of Pharmacology and Therapeutics in the University of Pennsylvania; Professor of Materia Medica, Philadelphia College of Pharmacy and Science. 1905 Chestnut St.

1880. Woodbury, Frank, M.D., Secretary to the Committee on Lunacy of the Board of Charities of Pennsylvania. 3345 N. Seventeenth St.

*1911. Woods, Andrew H., A.B., M.D., Associate Professor of Medicine, Head of Division of Neurology, Peking. Union Medical College, Peking, China.

†1897. Woodward, George, M.D. W. Willow Grove Ave., Chestnut Hill, Philadelphia.

1913. Woodward, W. Wellington, M.D. 26 S. Church St., West Chester, Pa.

1903. Worden, Charles B., A.M., M.D. Princeton, N. J.

1889. Young, James K. M.D., Professor of Orthopædics, Graduate School of Medicine, University of Pennsylvania; Orthopædic Surgeon, Philadelphia General Hospital; Consulting Orthopædic Surgeon, Woman's Hospital and Philadelphia Lying-in-Charity. 222 S. Sixteenth St.

1894. Zentmayer, William, M.D., Professor of Ophthalmology Graduate School of Medicine, University of Pennsylvania; Attending Surgeon to the Wills Eye Hospital; Ophthalmologist to the Glen Mills School. 1506 Spruce St.

1899. Ziegler, S. Lewis, A.M., M.D., LL.D., Attending Surgeon to the Wills Eye Hospital; Chief Ophthalmic Surgeon to St. Joseph's Hospital; Membre Société Française d'Ophthalmologie. 1625 Walnut St.

1887. Ziegler, Walter M. L., A.M., M.D. 1418 N. Seventeenth St.

1895. Zimmerman, Mason W., M.D., Consulting Ophthalmic Surgeon to the Germantown Hospital. 1522 Locust St.

ASSOCIATE FELLOWS

(Limited to Fifty, of whom Twenty may be Foreigners)

American

ELECTED

1911. Abbe, Robert, M.D. 13 W. Fiftieth St., New York City, N. Y.
1909. Billings, Frank, M.D., 1550 North State Parkway, Chicago, Illinois.
1893. Councilman, William T., M.D., Harvard Medical College, Boston, Massachusetts.
1909. Crile, George W., M.D., 1021 Prospect Avenue, S. E., Cleveland, Ohio.
1909. Dana, Charles Loomis, M.D., 53 West Fifty-third Street, New York City, New York.
1892. Emmet, Thomas Addis, M.D., 91 Madison Avenue, New York City, New York.
1912. McCaw, Brig.-Gen. Walter D., M.D. Assistant Surgeon-General, U. S. A., Army Medical School, Washington, D. C.
1906. Mayo, William J., M.D., Rochester, Minnesota.
1906. Pilcher, Lewis Stephen, M.D., 145 Gates Avenue, Brooklyn, New York.
1906. Shattuck, Frederick C., M.D., 135 Marlborough Street, Boston, Massachusetts.
1894. Warren, J. Collins, M.D., 58 Beacon Street, Boston, Massachusetts.
1894. Weir, Robert F., M.D., 1155 Park Avenue (Ninety-second Street), care of Mrs. Ed. La Montayne, New York City, New York.
1892. Welch, William H., M.D., Johns Hopkins Hospital, Baltimore, Maryland.

Foreign

1890. Baccelli, Guido, Rome, Italy.
1908. Bannerman, W. B., M.D., General, I. M. S., 11 Strathearn Place, Edinburgh, Scotland.
1909. Macallum, Archibald B., M.A., M.B., Ph.D., Sc.D., LL.D., F.R.S., Department of Biochemistry, McGill University, Montreal, Canada.
1906. Myles, Sir Thomas, M.D., 33 Merion Square, W., Dublin, Ireland.
1898. Roddick, Thomas G., M.D., 80 Union Avenue, Montreal, Canada.
1908. Ross, Col. Sir Ronald, K.C.B., K.C.M.G., F.R.S., M.D., D.Sc., LL.D., 36 Harley House, London, N. W. I., England.

CORRESPONDING MEMBERS

1880. Carrow, Flemming, M.D., 823 David Whitney Building, Detroit, Mich.

1885. Rendu, Jean, M.D., Lyons, France.

1916. Estes, William Lawrence, M.D., South Bethlehem, Pa.

1916. Guitéras, John, M.D., Havana, Cuba.

1917. Miner, Charles H., M.D., Wilkes-Barre, Pa.

1917. Stevens, Cyrus L., M.D., Athens, Pa.

NECROLOGICAL LIST

FELLOWS

WILLIAM H. FURNESS, M.D.	August	11, 1920
WALTER J. FREEMAN, M.D.	December	20, 1920
WILLIAM M. WELCH, M.D.	February	8, 1921
CHARLES W. DULLES, M.D.	May	6, 1921
CHARLES H. THOMAS, M.D.	June	28, 1921
WALTER L. PYLE, M.D.	October	8, 1921
M. HOWARD FUSSELL, M.D.	October	15, 1921

ASSOCIATE FELLOWS

FRANKLIN P. MALL, M.D.	November	17, 1917

LIST OF PRIZES AND LECTURES

THE WILLIAM F. JENKS MEMORIAL PRIZE

(Triennial)

1889	John Strahan, M.D.	Belfast (Ireland).
1895	Abram Brothers, M.D.	New York.

Note—June 12, 1900, the William F. Jenks Memorial Prize Fund was transferred to the Library as the "William F. Jenks Memorial Library Fund."

ALVARENGA PRIZE OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA

(Annual)

1890	R. W. Philip, M.D.	Edinburgh (Scotland).
1891	L. Duncan Bulkley, M.D.	New York.
1892	R. H. L. Bibb, M.D.	Saltillo.
1894	G. E. de Schweinitz, M.D.	Philadelphia.
1895	Guy Hinsdale, M.D.	Philadelphia.
1897	Joseph Collins, M.D.	New York.
1898	S. A. Knopf, M.D.	New York.
1899	Robert Randolph, M.D.	Baltimore.
1900	David de Beck, M.D.	Cincinnati.
1901	George W. Crile, M.D.	Cleveland.
1903	William S. Carter, M.D.	Galveston.
1905	D. Chalmers Watson, M.D.	Edinburgh (Scotland).
1907	William Louis Chapman, M.D.	Providence.
1908	William T. Shoemaker, M.D.	Philadelphia.
1910	M. Katzenstein, M.D.	Berlin (Germany).
1911	Francis D. Patterson, M.D.	Philadelphia.
1914	H. B. Sheffield, M.D.	New York.
1915	J. E. Sweet, M.D.	Philadelphia.
1917	Wilburt C. Davison, M.D.	Baltimore.
1921	John W. Churchman, M.D.	New York

NATHAN LEWIS HATFIELD PRIZE FOR ORIGINAL RESEARCH IN MEDICINE

(Triennial)

1901	Henry F. Harris, M.D.	Atlanta.
1909	Martin Henry Fischer, M.D.	Oakland.
1917	A. B. Macallum, M.D., F.R.S.	Toronto.
1919	Harvey Cushing, M.D.	Boston.
1921	William R. Nicholson, M.D.	Philadelphia

NOTE.—November 29, 1913, by Supplemental Deed of Trust, the title of this Fund was changed to "Nathan Lewis Hatfield Prize and Lectureship."

WEIR MITCHELL LECTURES

Jan. 17, 1911	Arthur R. Cushny, M.D.	London.
Mar. 30, 1911	Edmund B. Wilson, Ph.D., LL.D.	New York.
May 16, 1911	Svante Arrhenius	Stockholm.
Nov. 3, 1911	William T. Porter, M.D.	Boston.
Mar. 29, 1912	William H. Howell, M.D.	Baltimore.
Oct. 21, 1912	G. H. F. Nuttall, F.R.S., M.D.	Cambridge (Eng).
April 4, 1913	H. P. Armsby, Ph.D., LL.D.	Pennsylvania.
Feb. 25, 1914	Harvey Cushing, M.D.	Boston.

PUBLIC LECTURES

Feb. 16, 1910	S. Weir Mitchell, M.D.	Philadelphia.
Nov. 17, 1910	Simon Flexner, M.D.	New York.
Dec. 15, 1910	William H. Welch, M.D.	Baltimore.
April 18, 1911	James G. Mumford, M.D.	Clifton Springs, N. Y.
Nov. 20, 1911	Talcott Williams, A.M., LL.D., Litt.D.	Philadelphia.
April 29, 1912	Owen Wister, A.M., LL.D.	Philadelphia.
Feb. 17, 1913	John K. Mitchell, M.D.	Philadelphia.
Feb. 15, 1916	Daniel J. McCarthy, M.D. and Walter Estell Lee, M.D.	Philadelphia.
April 15, 1916	Surgeon A. M. Fauntleroy	U. S. Navy.

MARY SCOTT NEWBOLD LECTURES

Mar. 29, 1917	A. T. McCormack, M.D.	Bowling Green, Ky.
April 4, 1919	Col. Thomas W. Salmon, M.C.,	U. S. Army.
Feb. 6, 1920	Alonzo E. Taylor, M.D.	Philadelphia.
Feb. 4, 1921	Maj.-Gen. Merritte W. Ireland	Washington.
April 20, 1921	Prof. William Romaine Newbold	Philadelphia.
Nov. 11, 1921	Robert McCarrison, M.D., D.Sc. LL.D.	Oxford, (Eng).

MÜTTER LECTURES

1865	J. H. Packard, M.D.	Philadelphia.
1866	J. H. Packard, M.D.	Philadelphia.
1867	J. H. Packard, M.D.	Philadelphia.
1868	Harrison Allen, M.D.	Philadelphia.
1869	J. H. Brinton, M.D.	Philadelphia.
1872	J. da S. Solis Cohen, M.D.	Philadelphia.
1879	S. W. Gross, M.D.	Philadelphia.
1882	E. O. Shakespeare, M.D.	Philadelphia.
1885	H. F. Formad, M.D.	Philadelphia.
1888	O. H. Allis, M.D.	Philadelphia.
1890–1891	Roswell Park, M.D.	Buffalo.
1893–1894	De Forrest Willard, M.D., and Guy Hinsdale, M.D.	Philadelphia.
1896	O. H. Allis, M.D.	Philadelphia.
1899–1900	J. B. Roberts, M.D.	Philadelphia.
1901	H. W. Cushing, M.D.	Boston.
1902	L. A. La Garde, M.D.	Washington.
1903	C. N. B. Camac, M.D.	New York.
1904	G. H. Monks, M.D.	Boston.
1905	A. O. J. Kelly, M.D.	Philadelphia.
1906	W. J. Mayo, M.D.	Rochester, Minn.
1907	J. Rogers, M.D., and S. P. Beebe, M.D.	New York.
1908	G. W. Crile, M.D.	Cleveland.
1909	H. D. Fry, M.D.	Washington.
1910	T. W. Hastings, M.D.	New York.
1911	C. F. Nassau, M.D.	Philadelphia.
1912	J. C. Bloodgood, M.D.	Baltimore.
1913	R. C. Coffey, M.D.	Portland, Ore.
1914	F. H. Albee, M.D.	New York.
1915–1916	Rudolph Matas, M.D.	New Orleans, La.
1916	Nelson M. Percy, M.D.	Chicago, Ill.
1917	Chevalier Jackson, M.D.	Philadelphia.
1919	Alexis V. Moschcowitz, M.D.	New York.
1920	J. Chalmers Da Costa, M.D.	Philadelphia.
1921	Professor H. C. Jacobaeus	Stockholm, (Swed.)

WEIR MITCHELL ORATION

1919	Charles W. Burr, M.D.	Philadelphia.

MEMOIR OF J. EWING MEARS, M.D.[1]

By RICHARD H. HARTE, M.D.

James Ewing Mears was born on October 17, 1838, in Indianapolis, then a small frontier town in the woods of Indiana. In 1832, it had a population of only about 1200, so it can readily be seen that at the time of his birth it was still a mere village in the oak forests of Indiana. His father, George W. Mears, was a physician, a graduate of Jefferson Medical College of the class of 1827, who, following the tide of western emigration, settled in the small struggling town, which was almost wiped out in the financial crisis of 1837. What the younger Mears did in those early and primitive days it is difficult to say, but as the boy portrays the character of the man, we can well see him in his early surroundings living the active life much as that great delineator of western frontier boyhood has so graphically described in *Tom Sawyer*. There is no doubt that he was a leader among the village boys, and ever ready to puncture the page of routine life with his fists when boyhood oratory failed to have the desired effect, as was so common in the early days of the Middle West. The boy who was slow in this respect soon lost prestige with his comrades. In those days caste was unknown, or if it existed was little recognized. The boy was generally known in the community for his standing in school and his ability to take care of himself in the rougher sports that were in vogue in those early days.

Mears was fortunate in his parents, as they were evidently

[1] Read January 5, 1921.

people of refinement and culture, having lived in Savannah for many generations, which may explain in a measure some of his southern characteristics. They evidently took more than a passing interest in his early education. We find that he graduated at Trinity College, Hartford, at the age of twenty. We find him, in 1858, with the degrees of A.B. and B.S. Here there appears to be a break in the sequence of his life, that is, the two or three years before the breaking out of the Civil War. It may be safe to say, however, that he was not idle. From conversation which I had with him I was led to believe that he lived in St. Louis before the war, as he was familiar with the local surroundings and with many people of that city, which, although quite small at that time, yet occupied a very important place in the country as a great commercial and distributing center. His intimate local knowledge confirmed many stories which have been current about the habits of a very distinguished general of the Civil War.

When hostilities were declared by the South we find Mears on the right side, as he invariably was later in life. He accepted a captaincy in the Quartermaster's Department of the Indiana Volunteers, and it was undoubtedly in this capacity that he acquired many of the business and executive qualities which were so characteristic of him in later years. Just how long he remained in this branch of the service, I am at a loss to know; with his prospective interest in medicine, we find him later serving as medical cadet and executive in one of the military hospitals. His dignified southern manner, with his heavy growth of hair and beard, gave the impression of a more matured person than could hardly be warranted by his years. There is little doubt that he performed his services thoroughly and to the satisfaction of his superior officers.

His father's profession and his being a graduate of Jefferson College were no doubt an influence in the younger Mears coming to Philadelphia to pursue his medical studies, as we find him a student in the class of '63 and '64, graduating in the class of '65 at the Jefferson Medical College, as two years in those days

were considered sufficient time to master the science and art of medicine. He was a good student, a close observer, well educated and of striking appearance; and being well presented, he soon made a place for himself in the eyes of the faculty, and particularly with the elder Gross, who then was regarded as the Nestor of American surgery, which reputation he acquired largely as a close student and an indefatigable writer rather than upon his skill as a surgical operator. After graduating Mears received an appointment as resident physician at the Blockley, now the Philadelphia General Hospital, where he served the usual term of one year. In that school of pathology he made many friends. By his close observation he detected a scar on the abdomen of a patient under his care. She subsequently died in the institution, and on careful postmortem examination it was found that only one ovary existed. He reported the case to Dr. Washington L. Atlee, who had operated on the case some years before (Atlee at that time was one of the early ovariotomists of the city), which operation was generally condemned by the profession. He procured the specimen for Dr. Atlee, which helped to prove his contention that ovarian cysts could be successfully treated by abdominal section. As the result, Mears became a frequent associate at the ovarian clinic of the elder Atlee and assisted in the publication of his cases. It was only a year after leaving Blockley that he became associated with the Jefferson surgical clinic, as well as associating himself with a number of young men for the formation of a quiz class, which later became most successful and played an important part in the medical education of Jefferson College. It was incidentally the result of his success as a quiz master that he was allowed to be recognized as a drill master for aspirants for the navy and army service, and doubtless many a navy and probably army surgeon who has done duty in the Great War has reason to be thankful for the rigorous ordeals he was obliged to submit to in order to pass his examination, which embodied every phase of a man's deportment from the time that he appeared and took his seat before the board. It was said that no pupil of Mears ever failed to pass successfully.

Consequently he was much sought after, and the number of those who profited by his instruction and discipline which he exacted must have been sufficiently large to exert a perceptible influence upon the morale of the service. Possibly one factor in his success was the fact that he had the courage of his convictions and never permitted an applicant to appear before the examining board who was not thoroughly prepared, and also declined instruction to those who were lacking in the requisite qualities to become competent officers.

Mears was a charter member of the American Surgical Association, with the elder Gross for president. Shortly afterward he was elected the first recorder of the *Transactions*, and from Gross received the following instructions: "See to it that the leaves are uncut." (Many years afterward, when the writer was elected to a similar office of the Association, his first instruction to the publisher was to see to it that the pages *were* cut, as he considered an uncut page in a book or magazine an abomination. And with all due respect to the great Gross, he feels that his suggestion, though given innocently, was more genuinely appreciated by the Fellows, and it was only by chance that Mears jokingly referred to it one day in Washington when commenting upon the early days of the Association.) Probably no Fellow has had the interests of the Association more keenly at heart or has guarded its future with more jealous care or has contributed more frequently to its volume and been more prompt with his manuscript. It was his ardent desire that the Association should acquire title to property in Washington for its permanent home, and I know full well, from conversation with him on the subject, that he was willing to finance the scheme to a very large extent. It was found inexpedient by the council, and he quickly dismissed the idea and became interested in other matters. But he never lost his interest in the Association. He was elected its president in 1893.

He was elected a Fellow of the College of Physicians in 1868, and became the recorder in 1872, a position later changed to editor of the *Transactions*. The College is indebted to his generosity

and thrift, as Mears was a liberal contributor to the building fund; and also owe to him the endowment of a book fund of $5000, known by the name of the donor. Later he became chairman of the Hall Committee, an office which he performed with great care and attention. Once I heard the late Dr. John Ashhurst remark, in speaking of Dr. Mears, "You may be absolutely certain, with Mears as chairman of the Hall Committee, that when cold weather comes there will always be ample coal in the cellar and the roof will be free from leaks." It is probable that his early training in the Quartermaster's Corps, with his own accurate and methodical ways, made him such a good executive. And any function in Philadelphia requiring personal attention or business detail was always likely to be entrusted to Mears, with a feeling that it would be carried to a successful issue. He possessed good, sound, business instincts, such as are rarely found in the profession, which if possessed to a reasonable degree we would find fewer of its members reaching an impecunious old age.

As to Mears's teaching ability, we find that he was professor of anatomy in the Philadelphia College of Dental Surgery; as a lecturer he was clear, concise and dogmatic, and there is no doubt that in his study on these lines he was the first to recognize the possibility of attacking the Gasserian ganglia for the relief of obstinate neuralgia, which like many early suggestions in surgery when first proposed was regarded as the thought of an unbalanced dreamer, and it required time for it to filter through the minds of the profession and to come forth as a clear and concrete proposition. He was demonstrator of surgery in the Jefferson Medical College and lecturer and gynecologist at the Jefferson Medical College Hospital. He was surgeon to St. Mary's and St. Agnes's Hospitals, and for a long time had a private hospital on South Broad Street, where he did much of his abdominal and gynecological work, as in those days facilities were not so perfect for the care of private patients in general hospitals as at the present time.

Mears wielded a facile pen. His work on general surgery was

well received by the profession. He gave special attention to oral surgery and wrote a valuable article on ankylosis of the lower jaw. He was deeply interested in eugenics and wrote extensively and forcibly on this complicated problem, in the most clear and convincing way; and if his writings could be read and studied by our legislators much good would result, and our annual crop of mental defectives would be reduced and an enormous portion of the burden of taxation removed. I quote here a few sentences from his book *The Problem of Race Betterment*, which expresses how forcibly and strongly he felt on this important subject:

"The circle of degeneracy is ever widened; each succeeding generation is more degenerate than that which preceded it; the inborn vices are intensified; the moral sense disappears; mentality exhibits itself only in the vaporings of the idiot, the incoherent ravings of the vicious insane, the cackle of the imbecile; and this is the human being who claims the care of the state to which he is an ever-increasing burden, who claims the protection of society which he pollutes and by his contaminating influence would degrade to his level. What is the remedy? How shall this most important problem be solved? The state when attacked sends forth its best citizens to battle in its defence; some are slain, some are disabled, but the state is saved and the slain are entombed with the honors of war, garlands cover their biers, the world proclaims them heroes, valiant sons of the state, who gave their lives that it might survive!

"Is it asking too much, is it requiring more than is due, when the state, through carefully considered legislation, which in every detail shall safeguard the inalienable rights of the individual, seeks to protect itself against the degrading influences of the continually flowing stream of transmitted pollution, which saps the mental, moral and physical vitality of its citizens, by asking the parents and guardians of the irresponsible defectives to yield their consent to the performance of an operation which in some instances may prove to be curative and in many to be palliative, by abrogating sexual perversions and thus establishing conditions favorable to mental and moral cultivation, and in all, through

its far-reaching results, is able to render them impotent to do harm? Failing to obtain this consent, has not the state the right to adopt such measures in the interest and in the protection of its citizens? Nay, further, is it not compelled to so act in the performance of its full duty to its citizens?"

As the result intelligent laws have been enacted by some of our states, and a similar act passed both houses in Harrisburg, only to be vetoed by the maudlin sentiment of the chief executive.

Mears had the good sense and judgment to give up active surgery when he was in his best estate, mental and physical; and being untrammelled by domestic responsibilities (having never married), he devoted much time to travelling and visited many parts of the world—Europe, Asia and Africa (as evinced by many of his published papers). Being a close observer, a social and communicative disposition, and evincing a keen interest in any subject, he was often permitted to see and learn much that the casual observer might fail to acquire. For a time he had a place in the country near New Hope, where he took a keen interest in farming problems; read papers and was a strong advocate of good roads, and in a short time was recognized as a decided factor in the community for good.

Besides his benefactions to this institution he presented a valuable medical library and its endowment to the medical society of his native state in memory of his father. He founded a scholarship in the medical school of his alma mater, and gave $10,000 to the Harvard Cancer Commission, besides leaving his residuary estate to Harvard College for the founding of a course of eugenics, to be taught in all its branches, and notably that branch relating to the treatment of defective and criminal classes by surgical procedure, believing this to be a subject which concerns most importantly the welfare of the human race. With this object in view I am informed he left about $100,000 to carry out his wish.

In reviewing the life and work of Dr. Mears I have tried to be just in every respect and to put aside my personal feelings. Although in no wise the superman, as one is often led to believe

after listening to some of the memorials read before this body, he did possess many fine qualities. Being a gentleman by birth and education, he started in life fearless and well armed, and if he at times used these weapons to advantage it may be one of the reasons why he was not more popular. He was honest and sincere, and if he once gave a hearty handshake, it was that of friendship and not the insincerity of the politician. He was spoken of at times as being difficult to get on with, which from my own experience I resent. He was utterly frank and able to express what he thought, fearless of the criticism of others, and ever ready to defend these opinions to the best of his ability. I repeat that he was frank and fearless, and, if I may so express it, he always fought in the open. It must be remembered that the atmosphere of the school with which he was so actively identified was of a much more tempestuous character than at the present time, which may possibly be one of the reasons why he was charged with a spirit of combativeness.

He lived his life: A lonely life, lacking that rare and helpful companionship which every normal man should share, and without which he is deprived of that which really stands for the best in life. The world is better for Mears having lived, and the communities which knew him best have profited by his acquaintance. If that can be said for the rest of us, we are fortunate.

He died suddenly, on May 28, 1919, with an attack of pneumonia at the Presbyterian Hospital. Few of his friends knew that he was ill; and his lifelong and trusted friend, Dr. Stryker, was with him at the end. His death was a decided loss to the world and to the profession, which he loved so dearly, and especially to the Fellows of this College and the American Surgical Association.

MEMOIR OF JAMES TYSON, M.D.[1]

By M. H. FUSSELL, M.D.

Pepper, Wood, Tyson, Agnew, Leidy, Penrose, Allen, Wormley, Norris, Duhring and Goodell.

There is perhaps no list of names which comprised the faculty of a medical school at one time which lends greater luster to that school than the list above. The men who had the honor to be taught by those masters of medicine in all its branches surely cannot expect again to see such a single group. Are we more appreciative of those who have gone before than of those who are with us? If that is the fact, then I crave forgiveness on the ground of great love, admiration and fealty to my teachers.

Of those great men, Horatio C Wood has but recently passed away. He was as different from James Tyson as two beings could well be, but was guided by the same spirit of "fair play" and intense interest in medical matters as was his less demonstrative, life-long friend and coworker, James Tyson.

James Tyson was one of my teachers with whom I became best personally acquainted, who honored me in his last years of life, and whose memory I love and revere. If what I have to say savors more of adulation than of cold-blooded analysis of Dr. Tyson's abilities, I have as my reason the great love for the man's character which I have experienced, and the desire to put in words before the public that reverence which I know all of those who knew him intimately have for his acts during his long and busy life.

[1] Read January 5, 1921.

James Tyson was born in Philadelphia October 26, 1841, at 41 Cheny Street, below Cherry Street. He died February 19, 1918. His father was Dr. Henry Tyson. His mother was Gertrude Havelin Tyson. They were members of the Society of Friends, and from his parents the son inherited his birthright membership in that Society, which he maintained to the end.

He was proud of his ancestors, who came from the Netherlands on his father's side and from England on his mother's side.

In notes made by Dr. Tyson on his genealogy, he is careful to point out that "The names, language and the literature of the Crefelders (Tiesens) show that they are Dutch and not German."

I would fain believe that his early training in the Society of Friends, his early education in the Friends' Central School and in Haverford College had much to do with the humility, the uprightness and sturdiness of his character, and that that education was the foundation of the principles which had governed his life as he announced in his last published writing l'envoi, "Fair Play," "Belief in Eternal Justice," "Faith in my Profession." I am well aware that the Society of Friends has no patent on the method of living exemplified in Dr. Tyson's life, but I rejoice in the fact that "Fair Play" and "Belief in Eternal Justice" were the lodestars of his life, and that he was a Quaker.

The liberality, the broadness of his life, is exemplified further by the fact that he loved and wed a Romanist; that their wedded life was serene and happy, never being marred by narrow religious tenets, but guided by "Fair Play" and "Belief in Eternal Justice" so long as they lived.

After Dr. Tyson's graduation at Haverford College (he gave the valedictory address to his class), in July, 1860, he entered the medical school of the University of Pennsylvania in the fall of 1860 and graduated in the spring of 1863, having taken another year in addition to the two-year course, then the prescribed course in the University of Pennsylvania. He was almost immediately appointed acting assistant surgeon in the United States Army, serving in the army hospitals in and about Harris-

burg—immediately preceding, during and after the battle of Gettysburg. After a short term of service in the army he was appointed resident physician at the Pennsylvania Hospital, and gives as his reason that the Pennsylvania was a civil hospital and gave him an opportunity to round out his education by contact with medical cases. In the Pennsylvania Hospital his companion residents were Thomas Andrews and Horatio C Wood. William Pepper, later Provost of the University, was acting apothecary, although still a student of medicine.

To the friendship and example of these great men I am sure Dr. Tyson owes much. After the expiration of the internship at the Pennsylvania Hospital, Dr. Tyson again became acting assistant surgeon in the United States Army. In the fall of 1864 he formed a quiz class in Philadelphia, together with Drs. Hickman and Horatio C Wood, which was the beginning of his long career as a teacher in the University of Pennsylvania.

Dr. Tyson says, "Practice did not come to me very rapidly," but I was acting assistant surgeon in the United States Army, had classes at the University and "did as much private practice as I could get."

In 1865-66 he gave a course connected with the University entitled. "Instruction in Microscopy." In 1868 this became part of the curriculum of the University of Pennsylvania. In 1866-67 he became assistant to Francis Gurney Smith, professor at the University of the institutes of medicine, at the munificent salary of $100 per year. This munificent salary has apparently never been changed as a proper remuneration for assistants at the University.

About this time, and until his induction as a full professor at the University of Pennsylvania, he was associated with Wood, Mears, Pepper, Allen, Maury and others at the College of the General Surgeons, Philadelphia Hospital and Philadelphia School of Medicine.

The above may be looked upon as a very brief review of the formative period of Dr. Tyson's life.

His work as a teacher and a member of the faculty of the school

of medicine of the University of Pennsylvania and his writing on medical subjects are activities which made him known to the medical world and endeared him to thousands of men in the medical profession.

His first appointment to the faculty of the University was the humble one of instructor in microscopy, the first teacher of that branch in the school. His next step was pathologic histology. He was then made professor of pathology. In the mind of the writer his pathologic teaching had largely to do with the presentation of the gross pathologic changes which occurred in the various diseased conditions. He however paid attention to the microscopical aspects of his subjects. The writer well remembers sitting in the old clinical amphitheater glancing through a portable microscope at specimens which seemed a glare of red and blue and did not convey much else to his freshman eyes.

I know that he aroused the interest of many of his students in the necessity of autopsies for a true understanding of the character of cases under a physician, and stimulated their determination to obtain postmortem examinations of the bodies of as many as possible of those who should die under their care.

He knew nothing at this time of the later and present conceptions of pathology, nor did he personally teach bacteriology in any of its branches. These were subjects which came into prominence about the time he was made professor of clinical medicine after the resignation of Sir William Osler from this chair, but he had the vision to inaugurate departments under his control under capable men who took good care of this newer work.

Tyson's interest in clinical medicine in various positions in the hospital as a member of the medical staff paved the way to his appointment as the successor to Professor Osler, and this in turn made him the logical successor to Professor William Pepper in the chair of the practice of medicine. This chair he occupied until his resignation in 1914.

His lectures lacked the masterly diction of Stillé and the brilliancy of Pepper, but his students attended his lectures with interest and left the benches well instructed. His lectures were

illustrated in practice by his professors of clinical medicine—Musser and Stengel.

The intimate friends of Dr. Tyson were much chagrined at the circumstances surrounding his resignation from the chair of the practice of medicine. Dr. Tyson at that time was advancing in years, and it was believed by certain individuals in authority that a younger man should be placed in charge of the department. That may have been a fact, but the manner in which the desires of this group were brought to Dr. Tyson's attention were, to say the least, cruel and unnecessary, and had a marked effect upon his mental alertness throughout the remainder of his life. It was only Dr. Tyson's humility and acceptance of finished facts which sustained him through his subsequent years.

During his years of service at the University occurred the entire change in policy of the medical school. When Tyson joined the faculty, the University medical school had a two-year course leading to the degree of doctor of medicine. In 1881 the length of the term was first extended to three years and later to four years, and an entire change in curriculum and requirements for entrance were made. For several years Dr. Tyson was dean of the faculty of medicine, and it was due to his loyal help and original suggestions that many of the changes were made. The University of Pennsylvania and the medical profession owe a debt of gratitude to James Tyson they will never be able to repay.

During his entire medical life he was an active member of the College of Physicians of Philadelphia, and much encouragement was given to the younger members by his ever-constant presence. His election to the position of President, which occurred in 1907, was one of the bright spots in his life.

The library of this College contains five volumes which speak of Dr. Tyson's industry as an observer, a teacher and a practitioner of medicine. His *Practice of Medicine*, his *Cell Doctrine*, his *Bright's Disease*, two volumes of reports and one of addresses must be analyzed to be appreciated. They all bespeak original research, painstaking observation and clearness of diction.

THE MAN. So far as I am aware there are no written records of the activities of James Tyson before he studied medicine. However, in Haverford College it is evident he was one of the elect of his class, as the valedictorian is usually a markedly popular individual.

Of James Tyson, the man, I have never heard a derogatory word. His kindness, his spirit of fair play and his unobtrusiveness endeared him to all. He was a man whose personal character was above criticism. Never did the finger of scandal point toward him. "To know him was to love him." The world is a better place to live in because of his life. All honor to our Fellow!

MEMOIR OF GEORGE S. GERHARD, M.D.[1]

By FRANCIS R. PACKARD, M.D.

The outstanding biographic facts in the life of George S. Gerhard may be briefly told. On the paternal side his ancestry was Huguenot; on the maternal, English. He was born January 19, 1849, at the house of his parents on Walnut Street below Fourth. His father, Benjamin Gerhard, was one of the foremost lawyers of his day in Philadelphia. His mother, Anna Sergeant, was the daughter of another distinguished lawyer, John Sergeant, a direct descendent of Jonathan Dickinson, the founder and first president of Princeton College, and of Jonathan Dickinson Sergeant, a member of the Continental Congress, who was prevented from signing the Declaration of Independence because of his absence from Congress at the time on some official mission in South Carolina. Two other daughters of John Sergeant married men who achieved national fame. One became the wife of General George Gordon Meade; the other the wife of Henry A. Wise, the Governor of Virginia.

After due preparation at Mr. Short's academy, George S. Gerhard went to the University of Pennsylvania, entering the collegiate course, but changing over to the medical school in his sophomore year. The medical curriculum at that time required but two years for its completion; but young Gerhard voluntarily took an extra year, graduating with the degree of M.D. in 1870. In the following summer he sailed for France, intending to follow his uncle's footsteps and study in Paris. His plans were frustrated

[1] Read April 6, 1921.

by the outbreak of the Franco-Prussian War, and he accordingly returned to Philadelphia, where he was elected, in 1870, to the position of resident physician for a term of two years at the Pennsylvania Hospital. Two of the physicians under whom he had the good fortune to serve, Dr. James H. Hutchinson and Dr. Jacob M. DaCosta, exerted a great influence on the young doctor, and he frequently spoke in after years of the invaluable experience he had acquired under their guidance. For several years after his term as resident physician had expired, he used to follow Dr. Hutchinson's rounds in the wards and take notes on his cases for him.

When the time came for Gerhard to commence practice on his own account he opened an office near Eighteenth and Spruce Streets. For a few years he remained in Philadelphia, filling in his time by working hard in the dispensaries of the Children's and the Orthopædic Hospitals. During this period he also assisted Dr. S. Weir Mitchell in his private practice, and the following anecdote is told of the manner in which terminated his services in that capacity. Dr. Mitchell had a nervous patient, a lady of great wealth, to whom he sent young Gerhard to administer electrical treatments. One day when Gerhard, carrying his electric battery, was waiting to be shown up to the patient's room, he heard a flunkey announce: "Madame, the electrician is waiting to see you." In a fervor of justly offended dignity he precipitately left the house and resigned the position which subjected him to such a misinterpretation of his professional position.

In 1876, the Centennial Year, he took the step which was to determine his subsequent career, and moved his lares and penates to Ardmore, where he soon acquired the unique position which he ever after occupied along the "Main Line" of the Pennsylvania Railroad. His first office was on Lancaster Avenue between Wynnewood and Ardmore, in the house now occupied, after enlargement and alteration, by the Lyman School.

It is hard to picture the circumstances and surroundings under which the young doctor began his professional career. There were but few of the large country places which now occupy what were

then farms. A few rich men had built handsome residences to which they moved their families during the summer. Suburbs as we now know them did not exist. Owing to the lack of transportation facilities persons of moderate means could not live in the country and earn their living in the city. The trolley, the telephone, and the automobile were things unknown. Not only was there no electric lighting, but even gas had not penetrated beyond the city limits. One important element was also lacking to domestic hygiene as well as comfort, namely, community water and sewage systems.

Dr. Gerhard's practice was widely scattered—from Philadelphia to Paoli, from Newtown Square to Conshohocken—and, though the number of inhabitants in the area was not so great as it now is, the distances to be covered were as great and the facilities to do so much less. Dr. Gerhard was a familiar figure all over the countryside. He kept good horses and would frequently change them, starting out with one and being met somewhere on his rounds by his coachman with a fresh outfit, the man with the one which he had been using returning to the stable. As there were no telephones by which questions could be asked or instructions given, much more personal visitings were required of the doctor. It was many years before other physicians came to ease the constantly increasing burden on Dr. Gerhard's shoulders. In the early eighties Dr. Robert H. Alison, his constant friend, settled at Ardmore. His professional aid and comradeship were a great comfort to Gerhard, and his death in 1906 a heavy loss.

The most overshadowing personal influence in Dr. Gerhard's life was undoubtedly that of his father's brother, Dr. William Wood Gerhard. In the preparation of this sketch I have been privileged to read a number of family letters of the greatest interest, some written by William W. Gerhard and some by Louis, which give a delightful glimpse of the relation between the French and the American medical profession in the eighteen-thirties and -forties. I must beg leave to digress upon the subject for a moment.

As is well known during the first half of the nineteenth century

the French were the leaders in medical science and teaching and young physicians from America flocked to Paris to round out their medical studies by working in the hospitals and clinics under Louis, Chomel, and Andral, the worthy successors of Bichat and Laennec. In Sir William Osler's delightful address, "The Influence of Louis on American Medicine," he gives a list of some of the young American physicians who studied in Paris in the decade between 1830 and 1840, and in it we find almost all the names of those who subsequently were the leaders of their generation in their profession in America. Osler says: "W. W. Gerhard was the most distinguished of the American pupils in Paris between 1830 and 1840. When you call to mind the men whom I have mentioned, this may seem a strong statement; but I feel certain that, could we take their suffrages, they would accord him the place of merit in consequence of the character of his work." Osler's statement is certainly striking when one reflects that among those other American pupils were James Jackson, Jr., H. I. Bowditch, Oliver Wendell Holmes, George C. Shattuck, J. C. Warren, and J. Mason Warren, from Boston; Alonzo Clark, Valentine Mott, Sr., and John T. Metcalfe, from New York; George W. Norris, Alfred Stillé, Charles Bell Gibson, and the first William Pepper, from Philadelphia.

Although these are great names, yet the palm for the most striking original work must be given to Gerhard. As the result of his work in the children's wards in the Paris hospitals he wrote the first accurate description of tubercular meningitis, and his studies and observations on diseases of the chest, especially on pneumonia in children, were of the greatest value. Gerhard's most remarkable achievement, however, was his absolute differentiation between typhoid and typhus fever. Gastro-intestinal fevers had been the subject of much special study on the part of Louis, and his researches on this subject, published in book form in 1829, were of inestimable value, although he failed to make the distinction between typhus and typhoid fevers. W. W. Gerhard returned to Philadelphia late in 1833, and early in 1834 he became a resident physician at the Pennsylvania Hospital. While working in that

capacity he became convinced that typhoid fever, then and for many years subsequently very prevalent in Philadelphia, was a distinct disease, characterized by inflammation and ulceration of the groups of glandular tissue known as Peyer's patches, located in the intestinal walls. After leaving the Pennsylvania Hospital he was appointed one of the physicians to Blockley, as the Philadelphia General Hospital was then known. Here, in 1836, he had the opportunity to study a large number of typhus fever cases, there being in that year an epidemic of that disease in Philadelphia. In these cases he found that there was a petechial eruption instead of the rose-colored spots of typhoid fever, that the intestinal glands were not affected by the characteristic inflammatory changes which he had observed in his cases of typhoid fever, and that, while typhoid fever was not contagious, typhus fever was very much so. The results of his observations, published in the *American Journal of the Medical Sciences* in 1837, established this differentiation beyond any doubt and placed Gerhard's name in the forefront of American medical scientists. His skill as a physician and his abilities as a teacher and writer maintained him in the foremost rank of his profession until his retirement from active professional work in 1868. He died in 1872.

George S. Gerhard, commencing practice just at the time of his uncle's death, never lost sight of the splendid example of his career. It seemed as though the older man had transmitted to his nephew his power of observation, his capacity for deduction from facts, his quickness of perception, and, above all, his love for his work and desire to render his life useful to others. But his life was too full of his daily round of toil to afford him leisure to record his observations. Beyond the report of a case of typhoid fever complicated by an abscess of the liver, the diagnosis of which was confirmed by autopsy, which he published in the *Medical News*, July 24, 1886, and a brief but most interesting paper, entitled, "Typhoid Fever, Historically," published in 1914, we know of nothing published by him.

There is an admirable French definition of a physician which seems particularly applicable to the career of George S. Gerhard:

"Il guérit quelquefois; il soulage souvent; il console toujours." As with all men who have a very large practice there were times when he was defeated in his combat with the great enemy, but Gerhard never admitted defeat until the end had come. Like the other great country doctor so feelingly described by Ian Maclaren, the sickbed of a desperately ill patient was to him a battlefield calling for the display of every faculty of skill, courage, and endurance on behalf of his patient by the physician who had assumed the responsibility of the struggle. Even though the odds might prove unequal and the patient and his guardian be defeated, nevertheless the sick man's sufferings might be alleviated and his mind consoled and those who loved him comforted by the exertions of the physician on his behalf.

Dr. Gerhard possessed in the highest degree the qualities which Dr. John Brown, the author of *Rab and His Friends,* deemed most essential in the physician: capax, perspicax, sagax, efficax. "*Capax* —there must be room to receive and arrange and keep knowledge; *Perspicax*—senses and perceptions, keen, accurate, and immediate, to bring in materials from all sensible things; *Sagax*—a central power of knowing what is what and what it is worth, of choosing and rejecting, of judging; and, finally, *Efficax*—the will and the way, the power to turn all the other three, capacity, perspicacity, sagacity, to account, in the performance of the thing in hand, and thus rendering back to the outer world, in a new and useful form, what you had received from it."

Because George S. Gerhard possessed these qualities he would have been a leader in his profession in any community. If he had remained in Philadelphia he would have undoubtedly achieved a high rank. Although he voluntarily chose to practice medicine in what was then a rural community he never neglected the scientific side of his profession: He was a frequent attendant at the meetings of medical societies; read the current medical journals and the most recent medical books; whenever some new discovery was announced he informed himself fully concerning it. No man was more anxious that his patients should have the very best medical or surgical assistance that could be obtained and he was

always the first when in doubt in any case to summon to his patient's aid some consultant who might help him. He possessed remarkable skill in diagnosis; but rather than risk his patient's welfare, if in doubt, would with rare modesty urge a consultation. Those who were privileged to consult with him were frequently struck with the accuracy with which even in special lines of work he would foretell what they would find.

It was not alone due to his professional qualifications that Gerhard was held in such love and esteem by those whom he attended. His devotion to his patients and his exertions for them were unlimited. Many tales have come to light, especially since his death, of the innumerable acts of kindness which marked his daily round. At all hours of the day or night he was ever ready to respond to the calls of those who needed his aid. For those who could not afford the proper food or medicines he would bring them. It was not at all an unusual thing for him to go into a kitchen and himself prepare the broth or food necessary for the patient. The poorer the circumstances of the patient the greater apparently would be the efforts expended by Gerhard in his behalf.

It was the appreciation of this constant self-sacrifice and devotion to his patients which enabled him to successfully carry out the great achievement of his life, the founding of the Bryn Mawr Hospital in 1893. For many years the demand for a hospital to answer the needs of the constantly increasing population along the Main Line had been apparent to him. Characteristically, he worked steadily but unostentatiously toward this end, talking whenever the opportunity arose, as when some special necessity demonstrated how useful such an institution would be; telling his well-to-do patients or friends what an opportunity there was to exert their benevolence in establishing it; interesting poorer persons in the community by informing them of the advantages which would be afforded by it for the care of those whose private means did not suffice for proper care and attendance in their homes. When he actually received a sum of money sufficient to begin the realization of his project his unceasing preliminary work had so prepared the people of his vicinage that contributions came

from all quarters. Rich and poor alike had been prepared and when they saw the hospital in substance, assured a beginning, they rallied to continue the good work. Today the Bryn Mawr Hospital has not only grown in size but in practical usefulness far beyond the conceptions of its founder. Its care of the sick and injured is accompanied by active scientific work, and if the spirit of William Gerhard can contemplate the work of his nephew, we may imagine that he may feel that it is direct fruition of the harvest which he sowed when he labored under Louis in the hospitals of Paris; and we may feel that this work of George Gerhard's is some return of the debt which our country can never fully repay to France.

Although not in good health for some years prior to his death, he yet attended many of his old patients who were unwilling to give him up. After paying a professional call on the morning of October 27, 1920, he had just entered the door of the Bryn Mawr Hospital when he was seized in an attack of acute dilatation of the heart. He was removed to a room in the hospital, where he died the next day, in that hospital for which he had labored so unceasingly.

His funeral, at Saint Stephen's Church, was attended by a throng of old patients, friends, and professional associates, anxious to pay their last sad tribute of affection to one whose whole life had been passed in the service of his fellowmen.

THE ANNUAL ADDRESS OF THE PRESIDENT[1]

By WILLIAM J. TAYLOR, M.D.

The By-Laws direct that I, as President, must inflict upon you an annual address giving a *résumé* of the work of the College during the past year, but I will be as brief as possible and only detain you a reasonable time.

Scientific Business. The Committee on Scientific Business has made numerous efforts to arrange the program of the various meetings so that the interest of the Fellows would be secured and a full attendance assured. Many of the restrictions to the full attendance of the medical public have been done away with and large numbers of post-card invitations have been sent to practitioners and medical students, and on the whole much has been accomplished. Whether it has been due to the post-war apathy or great numbers of medical meetings I cannot say, but the attendance of Fellows has not been all that could be desired.

The stated meeting of March 3d was devoted to the reading of a memoir of the late Sir William Osler by Dr. Thomas McCrae; a sketch by Dr. Hobart A. Hare, "Sir William Osler as Teacher and Clinician"; by Dr. Charles W. Burr, "Sir William Osler as a Man of Letters"; by Dr. Francis R. Packard, "Sir William Osler and the Library of the College of Physicians," while Dr. George W. Norris spoke of Sir William Osler as "Host to Americans in England during the Great War."

It is needless to say how deeply we all mourn his loss to us and

[1] Read January 5, 1921.

to the world of science and literature, while his never-failing interest in the welfare of our library will be irreparable.

On March 19th we met in special session to do honor to the memory of a former President, the late Dr. Horatio C Wood, at which time Dr. George E. de Schweinitz read a memoir of him and Dr. Hobart A. Hare some "Recollections of a Pioneer in Pharmacology;" Dr. Francis X. Dercum gave "An Appreciation," and Dr. Charles K. Mills some "Reminiscences, chiefly neurologic and medico-legal.

Although it had been many years since he had been able to take any part in the proceedings of the College, being an invalid and for a long time confined to his home, the meeting was largely attended by the Fellows and by his friends.

He left as a bequest to the College a sum of $1000 as a Trust Fund, the interest to be used for the maintenance of the Wood Room.

The third Mary Scott Newbold Lecture was delivered on February 6th by Dr. Alonzo E. Taylor, whose subject was "Post-war Conditions and Problems of Civic Organization in Europe."

The Mütter Lecture for 1920 was delivered by Dr. Alexis V. Moschcowitz, professor of clinical surgery in Columbia University, New York City, upon "Newer Conceptions of the Pathogenesis and Treatment of Empyema."

On April 15th a dinner was given in Mitchell Hall to the Fellows of the College, the expense ($1445.74) being defrayed from the Weir Mitchell Entertainment Fund, the income of which had accumulated for a number of years, and 275 Fellows were present. It was hoped that by bringing them together in this way and by speaking of the needs for hearty coöperation upon their part in the affairs of the College that greater interest might be created in scientific work. The seed so sown seems to have borne some fruit, but the crop this year at least has not been abundant.

Dr. Richard H. Harte was appointed by the President a Trustee to serve for three years under the will of the late Thomas Skelton Harrison.

Dr. Simon Flexner relinquished the custodianship of the Rush

watch and Dr. William H. Welch, of Baltimore, was appointed in his place and confirmed by the College at the March meeting.

The collection of portraits has been increased by the gift of a painting of our former President Dr. Richard H. Harte, which was presented on behalf of his family by Dr. Francis R. Packard.

A portrait of the late Dr. Michael Lieb, a founder of the College, was also received as a legacy to the College from the late Thomas Skelton Harrison.

During the year a memoir of the late Dr. William H. Bennett was read by Dr. D. J. Milton Miller.

LIBRARY. The report ofthe Library Committee, presented by its chairman at the December meeting, shows a marked increase in the number of volumes during the year, now amounting to 109,471 volumes (an increase of 4222 during the year). With the coming of peace, many foreign publications and journals which were unobtainable during wartime have been purchased and added to our shelves, but there are still certain volumes which we need to complete our files and which we hope soon to obtain.

The total number of Incunabula is now 286 titles (268 volumes).

DIRECTORY FOR NURSES. The Directory for Nurses has had a very successful year, and has been able to make its usual handsome addition to the income of the Library of the College. Our thanks are due to the committee and employees for their efficient management.

The Committee on Public Health and Preventive Medicine has carefully considered all matters within its scope and has brought them to the attention of the College. At the stated meeting of October 6th a resolution was passed by the College urging the Board of Education the daily systematic teaching of personal hygiene in the public schools, and warmly advocating increased facilities for universal physical training in our colleges and universities.

FINANCE. The financial condition of the College is very satisfactory, and our thanks are due to the Committee on Finance for the good judgment shown in the management of our investments.

The annual volume of *Transactions* has been delayed owing to the difficulties of printing with its great increase in cost.

Mütter Museum. The Committee on the Mütter Museum reports the Museum to be in excellent condition and proposes to publish the Mütter lecture delivered in December by Dr. J. Chalmers Da Costa, "Osteitis Deformans, or Paget's Disease of the Bones," in the annual volume of the *Transactions* of the College, the committee to bear the expense. The Museum is now much used by visiting physicians and many Fellows for class instruction.

Council. The Council held nine meetings and considered and acted upon all matters referred to it by the College, and other business originating in the Council has been submitted to the College with recommendations.

A review of the work of the College would not be complete if mention were not made of the faithful and efficient services of the Librarian and Superintendent, Mr. Charles Perry Fisher, and Miss Zelner, the clerk of the College. To both our thanks are due.

Membership. The College has lost during the year by death eleven Fellows:

Dr. Nathaniel Gildersleeve, who died November 11, 1919.

Dr. D. Murray Cheston, who died December 22, 1919.

Sir William Osler, who died December 29, 1919.

Dr. Charles McIntire (Corresponding Member), who died January 3, 1920.

Dr. Hilary M. Christian, who died January 8, 1920.

Dr. Francis T. Stewart, who died February 4, 1920.

Dr. Samuel D. Risley, who died April 1, 1920.

Dr. Robert N. Downs, who died May 1, 1920.

Major-General William C. Gorgas, Surgeon-General, U. S. Army (Associate Fellow), who died in London July 4, 1920.

Dr. John C. Reeve (Associate Fellow), who died September 15, 1920.

Dr. George S. Gerhard, who died October 27, 1920.

Twenty Fellows were elected, showing an increase of seven. The roll of the College on December 1, 1920, included:

Fellows		474
Associate Fellows—American	14	
" " Foreign	6	
		20
Corresponding Members		6
		500

THE USE OF GENTIAN VIOLET IN THE TREATMENT OF INFECTIONS.[1]

By JOHN W. CHURCHMAN, M.D.

The first observations as to the selective bacteriostatic power of gentian violet were made in 1912, and since that time I have carried out studies in the laboratory and wards to investigate the biologic nature of this phenomenon and its possible application to the treatment of infections. It is these studies to which I wish to call your attention tonight. Let me make clear at the start that it has been my purpose in this work not so much to establish the bacteriostatic power of a given substance (though within certain limits this has been done) as to investigate the underlying principles and throw some light on the processes involved in the treatment of infections with selective agents.

Gentian violet has a selective power over bacteria in the sense that it prevents the growth of the Gram-positive bacteria, but is without effect on the growth of the Gram-negatives. This parallelism is very striking, though not absolute, for there are about 10 per cent of exceptions in each group. For many of the Gram-positive organisms, even for so hardy a bacillus as the spore-bearing subtilis, the dye is antagonistic even in extremely weak dilutions (1 to 1,000,000).

Gentian violet seems, on the other hand, to have very little toxic effect on the tissue cells. At least it has been possible to grow living tissue in media containing the dye and to observe the stained dividing nucleus.

Nor does the toxicity of the dye for experimental animals, when

[1] Read February 2, 1921.

injected intravenously, seem very great, though when introduced into the circulating blood in this manner the stain soon undergoes a change and disappears.

The dye also has a penetrating power for mucous membranes and persists in the cells for some time. This fact has been demonstrated by experimental injections of the living human knee previous to amputation at the mid-thigh. The synovial membrane in this knee was stained down to the subsynovial tissues. We have been interested to find that the effect of this dye on bacteria varies in a very remarkable way with the number of organisms present. If single bacterial cells, of a strain which apparently grows unimpeded in the presence of the dye, are planted in broth containing gentian violet no growth occurs, whereas if small groups containing thirty individuals of this strain are planted growth always takes place. There is, that is to say, a striking difference between the behavior of one bacterium and thirty bacteria in the presence of this dye. To this discrepancy in behavior we have given the name communal activity. Its nature is not at present understood, but there are some indications which lead us to think that the phenomenon indicates that bacteria do not grow quite in the independent and individual way usually assumed, and that they do, in fact, have some effect on each other's growth.

We have also observed that dead bacterial bodies have a remarkable effect on the growth of living bacteria planted in their neighborhood. For example, B. subtilis will not grow on agar containing this dye in strengths of 1 to 1,000,000. But if the surface of the agar on which the transplants are made be first smeared with dead organisms a fair growth of B. subtilis occurs when this organism is inoculated on top of them. The significance of this observation for the treatment of wounds will be clear. A thin layer of bacterial bodies might completely protect against the action of an antiseptic agent the living bacteria which one is attempting to reach.

The characteristics of gentian violet which were experimentally established in the manner indicated seemed to warrant an

attempt to test its effect in the treatment of infections under certain very sharp limitations. The first type of disease attacked was purulent arthritis. A special apparatus was first devised by which it is possible to wash thoroughly the surface of the joint through a large-caliber needle inserted under local anesthesia, and then to introduce the dye and thus to stain the synovial membrane.

Three groups of cases have been treated in this way:

1. Staphylococcus arthritis.
2. Pneumococcus arthritis.
3. Gonococcus arthritis.

The results in these cases indicate that it is possible, provided the infection is not too long established, to sterilize a joint cavity by the technic described.

An attempt was also made at the Walter Reed Hospital in Washington to sterilize with gentian violet granulating stumps which had become infected with Gram-positive organisms. In many of these patients B. diphtheriæ had persisted in the granulations for months and necessitated the isolation of the patients as carriers. It was possible in the small group of cases of this type treated to banish the diphtheria organism from the wounds without much difficulty. After the most careful mechanical cleansing the granulations were thoroughly painted with gentian violet, and it was possible to demonstrate, by very painstaking bacteriologic studies, that the organisms had actually disappeared,

DISCUSSION

Dr. Fred D. Weidman: Dr. David L. Farley has worked in our Laboratory of Dermatological Research at the University of Pennsylvania on the effect of gentian-violet upon some of the cutaneous fungi. Just as dyes have proved useful in isolating bacteria, we thought they could be utilized to restrain the ubiquitous skin bacteria which so often complicate the isolation of fungi, which is a large part of our laboratory work.

It was also thought that a certain constant individual restraining point might be determined for each of several dyes against each of the different species of cutaneous fungi, and that this, if found constant, might be useful in identification of species, much as we determine the thermal deathpoint for bacterial species.

Accordingly four representative fungi were planted upon graded concentrations of four dyes (brilliant green, malachite green, gentian-violet and neutral red) in solid culture media. The concentration ran from 1 to 1,000,000 up to 1 to 1000. We found that the two greens were the most powerful of all, consistently restraining all four of the fungi tested from twice to fifty-eight times as much as gentian-violet. Neutral red did not restrain any of the organisms even at 1 to 1000.

The restraining power of gentian-violet was found variable—1 to 170,000 for one organism, 1 to 70,000 for another, 1 to 40,000 for another, while the common green penicillium (glaucum) thrived at the comparatively enormous concentration of 1 to 1000. This dye, then, promises most from the standpoint of identification of species, the two greens for therapeusis, and inasmuch as the restraining point of gentian-violet for Gram-positive bacteria is so far below that of the moulds, it became evident that it could be used to assist in securing pure cultures.

Dr. Farley therefore went further and tested fifty-one different strains of organisms (including sporotrichums, actinomyces, numerous trichophytons and microsporons, epidermophyton inguinale, aspergilli and penicillia) against graded strengths of gentian-violet. As the immediate problem involved only concentrations of the dye somewhat above the restraining point for the Gram-positives the trials only extended over concentrations down to 1 to 100,000. The result was that none of these many strains was inhibited at 1 to 500,000 (the inhibitory point of S. albus), none at 1 to 250,000 and none at 1 to 100,000 except for Actinomyces bovis. It is safe, then, to conclude that moulds are far more resistant to gentian-violet than the Gram-positives.

The next step was clear, and on this basis we routinely use with good results a medium containing 1 to 250,000 gentian-violet for the primary isolation of cutaneous fungi.

We see from this that the restraining effect of gentian-violet on Gram-positive bacteria is also manifested on the moulds in general, but is not as powerful.

These higher organisms might prove to be very useful tools to use in running down the reason for the parallelism between Gram-positiveness on one hand and sentiveness to gentian-violet on the other. For some parts of fungous architecture are Gram-negative and others Gram-positive, and by separating these out and testing their growth-power

against gentian-violet we might arrive at a more definite opinion as to whether the inhibition was merely a function of Gram-positiveness or an inherent property.

All our work was done with Grubler's dyes, just as Dr. Churchman's was. Does Dr. Churchman know whether the several gentian-violets of American make have the same restraining titer? Also, is the restraining power different when the medium is sterilized before and after the addition of the gentian-violet?

It is curious that, as Dr. Churchman brought out, a single bacterium will not multiply in culture, but that, on the contrary, the association of a number is necessary. Might it not be that the planting of multiple organisms has the effect of introducing an enrichment, just as we add sterile rabbits' kidney to our media, and that a single organism cannot multiply without this?

Dr. Churchman (closing): Regarding my statements as to the effect of gentian-violet on the yeasts, I should say that these statements were based on experiments done with a 1 to 100,000 solution. I worked with only one variety of yeast and did not determine accurately just what strength of dye is necessary to prevent their growth.

My experiments have been done with Grubler's dyes. I have made a few experiments with American dyes, and apparently these have the same sort of action; but my experience with them is too limited to warrant any very positive statements.

THE SURGICAL ASPECTS OF BRONCHIECTASIS[1]

By GEORGE P. MÜLLER, M.D.

Bronchiectasis is the name given to a group of changes affecting principally the walls and lumen of the bronchial tubes which develops as a result of abnormal mechanical conditions in the lung parenchyma or of mechanical interference with the free passage of air (Davies). Bronchiectasis is, therefore, a late manifestation of some preëxisting disease or abnormality in the lung, and accordingly as it develops during the course of the disease, or at an appreciable interval after the subsidence of the primary lesion, may be regarded as a complication or as a sequela. Bronchiectasis is probably always acquired. A few cases of "fetal bronchiectasis" have been described,[2] but they bear but little resemblance to the acquired forms, the cavities resembling multiple cysts or even one large cyst (*Sacklung*). Some primary maldevelopment of the bronchial tree is the cause. The form of congenital bronchietasis usually described is not present at birth. It is the result of the absence of expansion (atelectasis) in one part of the lung and dilatation of the bronchi by a hypoplasia of the alveolar structure. The dilatations are converted into various-sized multilocular cavities with or without open communication with a bronchus.

The acquired form of bronchiectasis in varying degree is not uncommon, although it would seem to be so from current teaching. The difficulty lies in the fact that as usually taught we are led to believe that the disease is associated with a honeycomb

[1] Read February 2, 1921.
[2] Koeckert: Am. Jour. Dis. Child., 1919, xvii, 95.

appearance of the lung filled with pus. As Norris and Landis put it: "The currently accepted view that bronchiectasis is always characterized by large quantities of very foul-smelling sputum and that it is almost invariably an affection of the lower lobes must be revised. As a rule, only those cases are recognized in which the condition has become distinctly apparent and in which the symptoms are typical; and even in these cases the true nature of the trouble is often overlooked in the belief that tuberculosis is present."

In a study by McCrae, Thomas and Funk[1] of 1200 hospital admissions for advanced tuberculosis, 72 were found nontuberculous, of which 5 were due to a bronchiectasis.

The etiologic factors seem to be many, the principle being: bronchitis, acute or chronic, bronchial stenosis, obstruction by a foreign body, tuberculosis, syphilis, pleural effusion, pneumonia, adhesive pleuritis, etc.

The unusually high incidence of bronchopneumonia in recent years will probably result in a great many cases of chronic lung disease. That this is so is evident from the pathologic changes occurring in the pneumonia lung, particularly after lobular pneumonia. As described by MacCallum,[2] rapid organization of the inflammatory exudate is everywhere characteristic. This affects the alveolar and bronchial contents and they are replaced in part by connective tissue. It results particularly in interstitial new growth of connective tissue, which thickens the alveolar walls, the bronchial walls, the adventitia of bloodvessels, and the interlobular septa. The thrombosed lymphatics become organized and occluded permanently by fibrous tissue, so that new ones must eventually be formed, and absorption in the meanwhile is greatly hampered.

"Whenever there is an overgrowth of fibrous tissue in the lungs dilatation takes place. It may be slight and unrecognizable, or large, with definite bronchietatic cavities" (Packard). Davies states that the two principal variations from the normal which

[1] Jour. Am. Med. Assn., 1919, lxxiii, 161.
[2] Rockefeller Institute Monograph.

are responsible for bronchial dilatation and distortion are: (1) The traction force of abnormal fibrous-tissue formation in the lung parenchyma, and (2) interference with the free passage of air in the bronchi. "The mechanical disabilities which are the direct consequence of fibrosis in the lung are due to the fact that fibrous tissue, when it is the result of pathological changes, is in a constant state of contraction, and that the force of this contraction is exerted equally in all directions throughout the lung, and indirectly also on the mediastinum, the diaphragm and the thorax. The direct effect of the constant pull on the walls of the bronchi is a progressive distortion and dilatation of the lumen of the bronchial tubes. A second and very important result of this fibrous-tissue contraction is that it causes irregular constrictions which affect both the lung parenchyma and the bronchi, and therefore causes interference with the free entry and exit of air through the bronchus into the area of lung which it serves. Fibrosis is one only of several factors which may cause obstruction to a bronchus."

The influence on the bronchi of any interference with the free passage of air, from whatever cause, is described by Sauerbruch (quoted from Davies) as follows: "The difficulty (in the to-and-fro movement of air caused by the obstruction) is of much less importance during inspiration than during expiration. The stenosis is easly overcome during the powerful active inspiration. The air can thus enter. Normal passive expiration is not, however, sufficient to drive out the air. More air is pumped into the affected bronchi during inspiration than is expelled during expiration. Forcible expiration, as in coughing, shouting and singing, causes thus a very considerable rise of pressure, which, when it is constantly repeated, readily produces a widening of the affected bronchi."

It is not necessary to discuss the symptomatology of bronchiectasis. There is a stage when the symptoms are few and indicated only by shortness of breath and persistent cough. The early history of an acute onset with severe symptoms followed by subsidence, particularly in pneumonia or foreign-body groups,

is of great importance. A fresh cold or influenza attack, with exacerbation of acute symptoms and again a subsidence, may mark the earlier history.

Thinning and dilatation of the bronchioles, retention of secretion, and secondary infection is the inevitable end, and then the characteristic sputum signs become apparent. Not always fetid, but usually profuse in amount, the sufferer becomes an object of disgust to himself and to those about him.

In a case suspected to be one of bronchiectasis the roentgen-ray evidence assumes a great importance. Davies distinguishes four different types:

1. The chronic interstitial pneumonia type. The lung volume is diminished, the surrounding structures are displaced and the affected part of the lung has a homogeneous, ground-glass appearance; often in such cases nothing further is determined than an enlargement and elongation of the hilus shadow, which has become more opaque, and a more marked appearance of the diverging lines arising from it. Yet in general the clearness of the base is diminished, and in the middle of this diffuse grayish mist it is not uncommon to see either clear bands following along the tract of the dilated bronchi, or more opaque shadows situated irregularly and corresponding to the retention of a certain amount of fluid in the dilated peripheral bronchioles. Bronchial dilatation never attains the same degree of opacity as tuberculosis. Opaque shadows are found only when a new process is superadded.

2. The multiple dilated cavity type.

3. Bronchiectasis limited to the inner part of the lower lobe. This is a not uncommon situation, and when present on the left side the shadow in the lung due to the pathological changes is often difficult to see, as it is in a great measure obscured by that of the heart. Ventrodorsal and semilateral radiograms must always be taken. In this and the preceding type the localization of the lesion suggests that the disease is a sequela of a simple basal pneumonia or of a foreign body in the bronchus. A very noticeable feature of, particularly, the first and third of these types is the very great increase in obliquity and approximation

of the ribs. A marked change in the position of the ribs on one side of the chest associated with comparatively little evidence of disease in the outer and easily visible area of the lobe may be regarded as definite evidence of a bronchiectasis which is limited to the inner part of the lower lobe.

4. The chronic abscess type. Chronic abscess is usually associated with a terminal cylindrical bronchiectasis, and on the other hand the latter itself may give rise to abscess when the mucous membrane becomes ulcerated and the suppuration encroaches on the pulmonary tissue. Therefore, clinically chronic abscess and bronchiectasis can only very rarely be separated from one another, and then only by a knowledge of what has gone before. It is important to remember this from the standpoint of treatment, although the treatment of bronchiectasis, of whatever type, differs radically from that of chronic abscess uncomplicated by bronchial dilatation.

In taking up the matter of treatment, I feel that I must pass over the various medical measures advised in text-books and special articles. A brief review, in schematic form, is that of Meyer,[1] as follows:

1. Non-operative treatment:

(*a*) By way of the alimentary canal: Thirst cure.

(*b*) By way of the circulatory system: Intravenous injection of colloidal silver.

(*c*) By way of the respiratory system. (1) Inhalation of superheated air with a mixture of suitable drugs; (2) direct intrabronchial application of drugs per syringe or spray.

2. Operative treatment:

(*a*) Extrapleural: (1) Thoracoplasty; (2) Pneumolysis.

(*b*) Intrapleural: (1) Therapeutic pneumothorax; insufflation of nitrogen. (2) Incision of lung; pneumotomy. (3) Transposition of lung by means of suture fixation. (4) Ligation of branches of the pulmonary artery. (5) Extirpation of the diseased portion of the lung.

[1] Ann. Surg., 1914, lx, 7.

(*c*) Intrapericardial ligation of either main branch of the pulmonary artery (still in the experimental stage).

(*d*) Diaphragmatic; paralyzing one side of the diaphragm corresponding to the diseased lung by resection of the phrenic nerve in the neck (phrenicotomy).

"Medical measures can, in many cases, when the retention is due to postural rather than to mechanical difficulties, diminish the virulence of the infection and consequently the amount of the secretion. The symptoms and the patient's general condition are thereby improved. Such improvement cannot, however, be more than of a temporary nature, as no improvement of the mechanical conditions has been produced; nor can it occur at all if there is retention due to actual mechanical interference with the escape of the secretion" (Davies).

Yankauer, in 1916,[1] in one of the best articles on this subject, stated that it was possible with the bronchoscope to recognize and remove foreign bodies, whether or not they throw a shadow with the roentgen ray; to recognize carcinoma of the lung and to remove specimens for microscopic diagnosis at a stage when the disease is still operable and long before it could be recognized by any other method; to recognize and treat the results of old syphilitic lesions simulating bronchiectasis; to distinguish between dilatation of the larger bronchi, multiple peribronchial abscess, and a single abscess in any part of the lung, and accurately to locate the lesion.

In regard to treatment, however, he is not so reassuring. He used a double tube, which is introduced into the bronchiectatic cavity through the bronchoscope. Through the smaller tube normal saline solution is injected, while at the same time suction is applied through the larger tube. The fluid is removed as fast as it enters the bronchus. By directing the tube to various parts of the wall of the cavity a thorough irrigation is accomplished. It has been possible in this way to irrigate each lung with about eight ounces of salt water, at one sitting, under local anesthesia. The patients feel the solution enter the chest and can tell when

[1] New York Med. Jour., 1916, ciii, 257.

it has been removed. They do not object to the procedure. After two or three such irrigations the foul odor of the secretion disappears and the amount becomes very markedly reduced. Unfortunately, this beneficial effect does not last more than a few days, so that the irrigations must be repeated. He has done this in three cases, with good results as far as the odor and quantity of secretion are concerned, but none of the cases has been cured. Nevertheless, the result is striking, and it seems well worth while to continue the attempt to treat in this way these very unfortunate patients.

I do not think that collapse of lung by nitrogen displacement can be attended by much success except as a temporary measure and as a preliminary to a more radical operation. The bronchiectatic lung is irreparably diseased and must be permanently collapsed to expect a permanent cure. "It is obvious, therefore, that in order to obtain a permanent improvement, some method of treatment must be adopted which arrests the progressive fibrosis and which directly or indirectly produces approximation of the walls of the secondary and tertiary bronchi and of the air-passages beyond. Such approximation of the walls will obliterate the cavities, will prevent the retention of secretions and will thereby greatly diminish the infective processes. (It is quite rare for a dilatation of a primary bronchus to be associated with obstruction of the mouth of it. If there is no obstruction, there is free drainage, and therefore there is no necessity, though it would be advantageous, to produce approximation of the walls.) The measures which are necessary for obtaining the obliteration of the dilated spaces must at the same time ensure that no further traction on the walls of the bronchi by the fibrous tissue will take place" (Davies).

Time does not permit a full discussion of the various steps in surgical technic nor the variation of method applicable in the treatment of this disease. Pneumotomy, or simple drainage, has no place at all in the surgical treatment of bronchiectasis, except as a temporary measure to relieve the patient of the consequences of acute infection. The diseased lung tissue must be

excised. Every case of unilateral bronchiectasis is suitable for surgical treatment and even the bilateral cases may be considered when the disease is confined to the lower lobes. The anesthetic problem is a difficult one. The intercostal nerves should be infiltrated with novocain behind the angles of the ribs and the patient kept analgesic with gas-oxygen. Sometimes it is necessary to use ether, and in a case which I will report we had partial success with rectal ether anesthesia. Pressure methods are unnecessary. The matter of incision and exposure is still open to debate among thoracic surgeons. Some, such as Lilienthal, prefer an intercostal incision with rib-spreading. Others resect one or two ribs, to provide a thoracic window, and then either at this or at a subsequent stage open the pleura. The separation of adhesions necessary to deliver the lower lobe is often time-consuming, accompanied by hemorrhage and tearing of the lung. Robinson, in 1817, advocated stopping the operation after the lung was freed and packing the pleural cavity. In about two weeks the third or amputation stage is reached.

Davies, the English expert, prefers rib mobilization by a modification of the Wilms method performed in two stages. At the first operation he cuts his ribs posteriorly, and at the second, performed not later than a month afterward, the anterior sections of the rib are done.

The lung is removed after crushing along the proposed line of incision by means of the well-known Payr clamps. After the lung is cut away the stump is ligated by an interlocking suture to control hemorrhage. Separate ligation of the larger pulmonary vessels should be done. For many years various ingenious methods were practised to close the stump, but such are unnecessary when partial removal is practised. Even if a bronchial fistula develops it will invariably close if not allowed to come in contact with the skin. The analogy is similar to that of a fecal fistula after appendicectomy.

The next problem is that of the cavity and the management of the pneumothorax. I believe that the best results will be obtained by packing the cavity with vaselin gauze after the con-

clusion of the lobectomy. In twenty-four hours gradual removal should be done and the original gauze replaced not later than the third day with a lesser amount of packing, saturated with dichloramin-T in oil. The stump particularly should be treated with the chemical. When granulations have organized sufficiently to steady the mediastinum, a Carrel-Dakin technic is worth while unless a bronchial fistula develops. When the cavity becomes small or reduced to a sinus the familiar Beck's paste is a valuable adjunct in healing the wound. At all times I think it is well to control the treatment by counts of *cover-glass* smears and culture colonies.

If it is judged early that the cavity will be large, I believe that phrenicotomy should be done. This operation produces complete paralysis of the diaphragm on the same side and allows the arch to rise into the thorax several inches higher than the normal. The nerve is reached in the neck in association with the scalenus anticus muscle and the operation is easily done under local anesthesia. I will not dilate upon the operation proposed by Sauerbruch, namely, ligature of a branch of a pulmonary artery in order to produce carnification of the affected lung. The evidence available up to now does not show that it possesses any advantages over that of rib mobilization or over that of partial decostalization combined with section of the phrenic nerve.

It need hardly be emphasized that these operations are difficult, alarming and accompanied by a high mortality. On the other hand, the patient's condition is so hopeless and so wretched as to justify the risk involved. The case which forms the basis of this paper is as follows:

S. O., male, Russian Jew, aged forty years, watchmaker. Operated on for hernia seven years ago. Previous history has no bearing whatever on present trouble. Admitted to University Hospital, on Dr. Stengel's service, September 22, 1920. Was perfectly well until three years ago, when he got a cold in his chest, which lasted about two months, with a severe and frequent cough and some expectoration. Says he lost some weight then.

Had another similar attack that year and again one year ago, in the winter, when he brought up much sputum and was studied for lung tuberculosis; sputum was examined about eight times and found negative, but he was sent to White Haven Sanatorium, where he was discharged in three months as not having tuberculosis.

About two and one-half years ago he had a "spell of pleurisy" acute enough to cause pain, and a doctor put him to bed for ten days. No fluid was withdrawn. He recovered and never had a recurrence of chest pain since. Has never had any nightsweats. Has on three or four occasions noted blood in the sputum after a heavy attack of cough. None this year. Has been coughing steadily for a year, bringing up a yellow sputum, never foul-smelling or copious in amount. Does not remember ever having swallowed or getting choked on a foreign body.

On admission there was found impairment over the whole area of the right lower lobe, with diminished fremitis, both tactile and vocal. Breath sounds are somewhat distant and bronchial. As the base is approached these signs become more marked and over an area about the size of a hand the dulness is almost completely flat. There are very few rales and no satisfactory signs of cavitation. The diaphragm on the right side was fixed. The patient is distinctly acromegalic and a roentgen-ray examination of the skull showed enlargement of the sella. The fingers are quite clubbed.

Physical examination of the chest revealed an area of flatness to percussion on the right side posteriorly from a point 22 cm. from the vertebra prominens extending on down. On the left side the percussion note was normally resonant except for slight impairment at apex. Base is 36 cm. from vertebra prominens. There were a few rales but no signs of cavitation. Grocco's sign is doubtful. Respiration was shallow and expansion very poor. Breath sounds were normal on both sides but very distant over the area of flatness. Vocal and tactile fremitus were physiologic except in this area, where the former was diminished and the latter about absent. Further physical examination revealed

nothing of importance, the heart sounds being of good quality, normal in rate and rhythm.

The various reports on the examination of the sputum may be summarized by stating that it was seropurulent, minus elastic fibers, loaded with leukocytes, negative for tubercle bacilli and showing streptococci as the predominating organism. Blood Wassermann was negative; blood leukocytes numbered 10,000 with 70 per cent polynuclears and no eosinophilia. There were no parasitic ova in the sputa and the complement-fixation test for hydatid cysts was negative. There was no sugar in the urine and the blood sugar was 9.11 per cent. The temperature reaction showed a slight evening rise (99.2° to 100° F). The pulse averaged 90; the respiration were somewhat accelerated.

The roentgen-ray examination was thought at first to suggest a tumor of the liver but a "pneumoperitoneum" roentgen ray showed a shadow in the right lower-lobe area above the diaphragm. The liver is large, extending in the right flank to the level of the anterior spine of the ilium, but is not attached to the diaphragm above." The mass seems well defined, suggesting loculation of fluid.

Exploratory puncture was performed in the sixth interspace, one inch within the angle of the scapula. Without apparently going through an intermediate space, at about 5 cm. depth, thick creamy purulent material began to enter the syringe. It was so thick that only 1 or 2 cc would come through the needle. No inconvenience was suffered by the patient. Smear of the above purulent material showed: "Very many polymorphonuclear and pus cells. Very few Gram-negative rods and cocci. No tubercle bacilli were seen in the stained specimen. No hooklets were seen in the smear." Culture of the above pus sterile. No organisms recovered.

The patient was transferred to the surgical service, and on October 13, 1920, I operated under gas-oxygen and local anesthesia. Portions of the sixth and seventh ribs were resected in the posterior axillary line and a dense mass of adhesions encountered. The lung was fixed to the diaphragm and chest wall. It was explored

with the fingers and purulent material found, but no cavity. Bronchiectasis was established. The track was packed with gauze soaked in dichloramin-T.

The patient improved after this operation, but even before discharge (November 4, 1920) the cough had returned. He was readmitted on November 10, 1920, unimproved. The second operation was done November 18, 1920, under rectal ether anesthesia reinforced by chloroform. A portion of the eighth rib was resected and the wound enlarged. With considerable difficulty the lower lobe was isolated, clamped and cut away. The stump was ligated by chain ligatures. The middle lobe was held to the chest by adhesions. The cavity was filled with melted vaseline and then packed with gauze.

The patient made an uneventful recovery. Dichloramin-T was used in the subsequent pack until December 2, 1920, when only a sinus remained, which proved sterile. The following day a small fistula developed. Beck's paste (10 per cent) was used, and on January 5, 1921, the wound was entirely healed. The patient was entirely well at this time and free from cough.

Dr. Speese reported on the portion of lung removed: Diffuse fibrosis with bronchiectasis.

(One month after this patient was shown to the College he returned with symptoms indicative of abscess and the wound was reopened and a quantity of pus evacuated. He was treated in the surgical dispensary for about ten weeks, at the end of which time he was healed. From then until the end of February, 1922, he remained in excellent health and practically free from cough and entirely without expectoration. Some pain in the side was then experienced, and he returned to the hospital in March, at which time I made a small incision in the scar and evacuated some bloody pus and found a small fistula. At this time (March 27, 1922) he remains in excellent health, although still having a tiny fistula.

This paper was read before the publication of the papers by Lynah and Stewart, in which they suggest the injection of bismuth for the diagnosis of bronchiectatic cavities. In connection

with the work of Yankauer should also be mentioned the paper by Kully (1921), who reports that he has given 1054 bronchoscopic treatments and cured 4 out of 29 cases of chronic pulmonary suppuration.)

DISCUSSION

DR. O. H. PERRY PEPPER: I do not feel sure that the full significance of this report of Dr. Müller's is apparent on the surface.

Extensive pulmonary surgery in a condition such as bronchiectasis is attended with such difficulties and such a high mortality that the report of a successful resection of a lobe is a far greater achievement than the speaker's modesty has permitted him to intimate. As a sample of the difficulties, let me quote the steps taken by Lilienthal in a case on which he operated for abscess of the lung following tonsillectomy, and which he reports with evident pride. At the first operation he resected the greater part of the seventh rib and sectioned the sixth rib; he ablated the lower, middle and part of the upper lobes, carbolized the stump and placed a pint of paraffin oil in the chest and closed without drainage. Later he opened and drained a quart of foul fluid. Later he opened more widely and drained. Still later he packed the whole cavity with gauze. Then he resected the phrenic nerve and finally resected the eighth, ninth and tenth ribs.

It is easy for the medical man to be adversely critical of the radical nature of surgical intervention in lung disease and of the high mortality which is still incident to these operations, but before doing so the internist should take several points into consideration. First, that bronchiectasis from the very nature of the process producing it must in the majority of instances present a very different problem from abscess. Secondly, that it is the internist's duty to select the cases of bronchiectasis which are suitable for operation just as it is his duty to select the cases of anemia suitable for splenectomy. Thirdly, he must balance the efficacy of medical treatment and the prognosis under it with the result of surgery in similar cases.

Concerning empyema, there is no doubt as to the advisability of drainage, and has not been since the time of Hippocrates. Abscess of the lung after but short observation soon becomes surgical, although operation apparently only slightly lowers the mortality. Bronchiectasis, on the other hand, is so often widespread through one or both lungs that but few cases, perhaps only 1 in 200, present conditions suitable for surgery.

When, however, the process is unilateral and localized to one base and the patient is young and robust, then operation may be considered, always making sure before that the process is not tuberculous, syphilitic or due to pulmonary spirochetosis. It would also seem that the patient's vital capacity should be determined and the extent of the thoracic opening kept within safe limits.

On the other hand, medical treatment has little to offer. Vaccines are of little value and medicines of but little more. If you would appreciate the futility of medical treatment, read the measures suggested in the article on bronchiectasis in the new *Oxford System*. One measure does give relief in many cases, and that is postural drainage, but it must be conscientiously carried out over a considerable period. What other measures are available? Collapse of the affected part by artificial pneumothorax has been advised, but this is often impossible because of adhesions or the extent of the process.

Bronchoscopic treatment may be employed when the area can be directly entered with the bronchoscope. By repeated flushings there may be hope of cure, but this is said to be a long, tedious process and the individual treatments may be followed by severe systemic reactions with high fever. It must not be forgotten that a foreign body may be the primary cause of a bronchiectasis, and if so the bronchoscopic treatment will include removal of the foreign body.

All this sounds discouraging, and it must be admitted it is; but one should face the situation honestly and not be led by discouragement to advise operation, in desperation, in unsuitable cases, thus raising the operative mortality so high that the conservative will not advise the operation even in the suitable cases which could be cured, as this case of Dr. Müller's has been.

Dr. Müller (closing): The difficulty with these cases is that you have an infected area. After treating the lung you would think nature would come to the rescue, but she does not. We must either compress the lung out of existence or take it out. If you take it out you have a cavity which starts with an infected stump, and it should be treated before it is grossly infected. It must be obliterated. I do not believe that a sterile cavity can be left for any length of time; always reinfections occur.

THE NON-OPERATIVE TREATMENT OF CHRONIC EMPYEMA[1]

By JOHN H. GIBBON, M.D.

Just two years ago I read a paper before the College in which I tried briefly to indicate some of the advantages which civil surgeons might derive from four years' experience in military surgery, and tonight I shall endeavor to show that in one field at least the predictions made then have been realized.

Chronic empyema represents one of those conditions which has taxed surgical ingenuity to the utmost, and which has demanded for its cure operations which, in their turn, are accompanied by a high mortality and if successful still leave the patient crippled and handicapped for the more arduous occupations and recreations of life. I refer to the extensive rib resections which bear the names of Estlander and Schede, the decortication of the lung, of Fowler, and any of the other methods employed for carrying the chest-wall into the lung or bringing the lung out to it. Of course other less severe methods, such as the injection of Beck's paste, have caused some of the smaller cavities to heal, but success has been limited and failure has been followed by the more formidable plastic operations.

It is a wise man who profits by his misfortune and the same may be said of a race or generation. Within the past few years the world has passed through its greatest misfortune within the memory of man, the World War. Surgery has always profited by war—in experience, in new devices, in discoveries and in new methods of treatment—and the great world struggle of five years registers no

[1] Read April 6, 1921.

exception, for the treatment of wounds has been revolutionized and the treatment of infections enormously advanced.

Before this war a surgeon who dared to close without drainage a penetrating wound of the chest would have been liable to suit in case of death, and yet today a failure to close such a wound completely would be looked upon as a surgical mistake. The attempt to sterilize a suppurating pleural cavity is no new idea (Beck's paste and Murphy's formalin injections), but it was the war which brought about its practicability and realization.

Chronic empyema, except the tuberculous type, results from an uncured acute infection of the pleura or from the presence of a foreign body in the pleural cavity. The foreign bodies which prevent healing are not confined to the missiles of warfare, as those of you know who have removed drainage tubes which had been "lost." We have all dreaded these old suppurating pleural cavities and our patients have often passed from the hands of one surgeon to another, hoping their next operation would be their last; only too often it is.

The horrible shell-wounds of the thorax gave the military surgeon a wonderful opportunity for study, and the advance that was made in this field of surgery was one of the greatest that has ever been made. At the close of the war fairly definite rules could be laid down for the treatment of these cases. There was a large group which required no operation whatever, those operated upon were closed completely and the cases which later suppurated were subjected to some method of sterilization. These rules need not be rehearsed here, nor need anything be said of Dakin's solution or the Carrel method of employing it. The journals, recent monographs and text-books have made them known to all.

The application of the Carrel-Dakin treatment in acute empyema has also been extensively discussed in the recent surgical literature, and I am of those who believe that every case of acute empyema if it survives the immediate result of infection can be sterilized and cured by the painstaking employment of this method of treatment, and I share the hope of others that it will become more generally used, for I believe that its intelligent use will reduce enormously the cases of chronic empyema.

Since January, 1919, when I returned to the practice of civil surgery, I have operated upon eighteen cases of acute empyema and in all I have started the Carrel-Dakin treatment usually within forty-eight hours after the drainage of the cavity. Except one case that died and two recent cases still in the hospital, sterilization and healing have taken place in all but one, who is tuberculous and still has a little drainage, although he is working and earning his living. I admit that such experiences might be readily duplicated by simple drainage, especially in children. My youngest patient was eighteen years of age and the others ranged between twenty-one and fifty. I am convinced by my previous experiences that some of these patients who had large collections of pus of weeks' duration would have remained unhealed today under the old method of treatment.

In view of the fact that the chronic case follows the acute one, I think that it may not be amiss to refer to recent changes in the treatment of the acute case which I believe tend to the prevention of the chronic condition. In the first place, I no longer try to make a low opening into the cavity because a low opening makes it difficult later to keep the cavity filled with the solution except with the patient in the recumbent position and sometimes only with the chest lower than the pelvis. I think that the opening in the chest-wall should be made at a point over the collection of pus, which will enable one after the operation to keep the cavity filled with Dakin's solution even when the patient is sitting up or on his feet. In recent cases I have not made a rib resection but simply an intercostal incision, and I have given up attempts to remove from the cavity large masses of lymph and the liberation of the lung by digital separation of the adhesions. If the lung will expand in old chronic cases, where it has been bound down for months and years, when the cavity is sterilized and closed, it has seemed to me that it would do so all the more readily in the acute case, and I am sure that it does do so. These changes, then, render the operation in the acute case much simpler and I believe tend greatly to reduce the mortality.

To Depage, of Brussels, belongs the credit of demonstrating that an empyema of long standing of any size may be rendered sterile with Dakin's solution and then closed or allowed to close. I look

back to February, 1918, with the greatest satisfaction, when, at a surgical meeting in Paris, Tuffier exhibited some twenty-five cases of empyema, nearly all of gunshot origin, which he had cured by this method, and I consider it one of the most valuable contributions to chest surgery. He generously gave Depage all the credit. One of his cases seemed quite remarkable and the recollection of it has saved me discouragement and caused me to persevere in a number of very troublesome cases which I have since encountered.

Tuffier's case was that of a soldier whose cavity, after a shell injury and infection, occupied nearly the whole of the right chest and was of many months' duration. It was sterilized and closed, only to fill up and reopen in a month or two, when, however, a roentgen-ray plate showed the cavity to be one-half its original size. It was again rendered sterile by the Carrel-Dakin method and again closed, but once more it refilled and reopened. The roentgen-ray plate on this occasion showed the cavity to be one-fourth its original size. For the third time it was sterilized and closed and had remained closed, the last plate showing complete expansion of the lung. My feeling on seeing and examining this case was that any chronic empyema could be successfully treated in this manner, and my experience since, in spite of one or two very discouraging cases, has confirmed this belief. Even some of my acute cases have been very obstinate, but I believe that I have learned the usual causes of delay or failure and that they have their origin in faulty technic. The slides which I show demonstrate what can be done in chronic empyema and that success depends entirely on how closely one adheres to the principles of the Carrel technic.

One of the most common objections to this method has been that it is troublesome and requires more attention than the average patient is apt to get in the hospital ward or his home. That such an objection is absolutely groundless is shown by the fact that two of the cured cases—the slides of which I show—carried out their own sterilization at home, obtaining fresh Dakin's solution at the hospital every two or three days. An intelligent and persistent patient can accomplish far more than an indifferent interne or overworked nurses. It requires enthusiasm and persistence, and without these failure is sure to result.

The most important points in the treatment are to bear constantly in mind that, in order to accomplish the sterilization, the Dakin's solution must remain in constant contact with the *entire* wall of the abscess cavity, that the solution must be properly made and fresh, and that the greatest care must be exercised to prevent reinfection of the sinus and cavity from the skin. To the neglect of one of these three things I attribute all of my own failures or delays. The delayed sterilization and closure in the acute cases, also, has been due to neglect in one of these three particulars. The low opening and the bed-rest have been potent factors in preventing the contact between the solution and all parts of the abscess cavity. One patient, an acute case, was many weeks in closing, due entirely to the fact that I had made the opening over the lower part of her cavity and that after operation she was not kept in the recumbent position but was allowed to sit up in bed and used the bed-rest for a greater part of the time. She healed promptly when she was made to occupy constantly a position which enabled us to keep the cavity filled with the solution. Again I have experienced delay in sterilization owing to the use of Dakin's solution which was too old. Reinfection of the cavity from failure to keep the surrounding skin sterile can be easily demonstrated by taking smears from the cavity, the sinus and the surrounding skin.

If cases such as shown by Tuffier, three years ago, and such as I show now can be cured, we should be able to cure practically all cases. A study of our failures will do more to improve our results than a complaisant contemplation of our successes. I have failed in certain cases where the infection was due to the tubercle bacillus, and in others where a persistent sinus had followed the Estlander or Schede operation. I have one case still under treatment after fifteen months. This man came under my care in November, 1919, about a year after his operation for empyema. He was running a continuous fever and had a cavity that would hold six or eight ounces. It was sterilized and closed in four weeks, but opened up again in another three or four weeks. Since then the sinus has opened and closed several times and it is open now, but the patient has gained weight and has been at work for six to eight months.

The plan of treatment in the chronic case has been as follows: The capacity of the cavity is estimated by filling it with the patient in such a position that the mouth of the sinus is higher than all parts of the cavity; its exact position and shape have been determined by injecting bismuth in oil and taking stereoscopic roentgen-ray plates. When this has been done we know the position which the patient should occupy during the treatment in order to keep the Dakin's solution in contact with every part of the cavity. This I consider one of the most important points in the treatment.

The question of operation is now considered. In the absence of necrosis of the rib or the presence of a foreign body no operation has been found necessary in our cases, unless a dilatation of the old sinus may be considered an operation. It is only necessary to make the sinus large enough to accommodate two or three Carrel tubes. Several of our cases have been cured with a single tube in the sinus and I have never had any trouble from contracture of the sinus. In the beginning of the treatment, if more than one tube is used, one of them is left open at the end or a catheter is used in order to permit a thorough washing out of the cavity once a day. The cavity is then kept filled with the solution, just enough being added every two hours during the day and every three hours during the night to keep it full. The tightness of the sinus around the tubes and the correct position of the patient should prevent the escape of the fluid. Unless care is given to the regular instillation of the fluid there is no use in trying this treatment, as failure will certainly be the result.

With the apparent disappearance of pus, smears are taken from the depth of the cavity and from the sinus. When these smears are negative for three or four consecutive days the tube is withdrawn regardless of the size of the cavity, and the sinus and the skin about it kept sterile with iodine until closure takes place. I do not think it is necessary to close the wound and I am almost sure that it is better not to do so. The operation may cause the liberation of dormant organisms in the tissues about the mouth of the sinus which in turn may cause a reinfection. Such infections were constantly seen in plastic operations done months after the complete

healing of gunshot wounds. If the cavity and sinus are not sterile when the tube is removed, pus will soon be found again in the discharge and the tube can readily be reintroduced. If a closure has been made and the cavity is not sterile one only discovers it by physical signs and fever, and before these develop the old cavity has become distended with pus. If a reaccumulation of pus occurs after closure or after healing of the sinus, as certainly will occur in some cases, the tubes must be reinserted and the sterilization repeated. I have had this experience several times in the acute cases.

It has been suggested that Dakin's solution causes bleeding and I have seen it in a few chronic cases. I do not think that it is apt to occur until the cavity is sterile, and if no organisms are present in the smears from the cavity and sinus the tube should be withdrawn and the sinus treated with iodine until closed. If bleeding occurs and organisms are still present, normal salt solution should be used for a time and then the Dakin's solution resumed.

Bronchial fistula is a very troublesome complication and renders the treatment difficult. I have had but two such cases and in both the opening into the bronchus closed with simple drainage of the cavity or under salt solution irrigation. The first chronic case we treated (Case I) had a bronchial fistula and it healed while the Dakin's solution was being used. I think that unless the fistula is large and the cavity a very old one it will usually heal if the cavity is kept empty. It may be necessary in these to make a low opening in order to get drainage, but I have not had to do it. We often see these fistulæ heal after the drainage of a lung abscess.

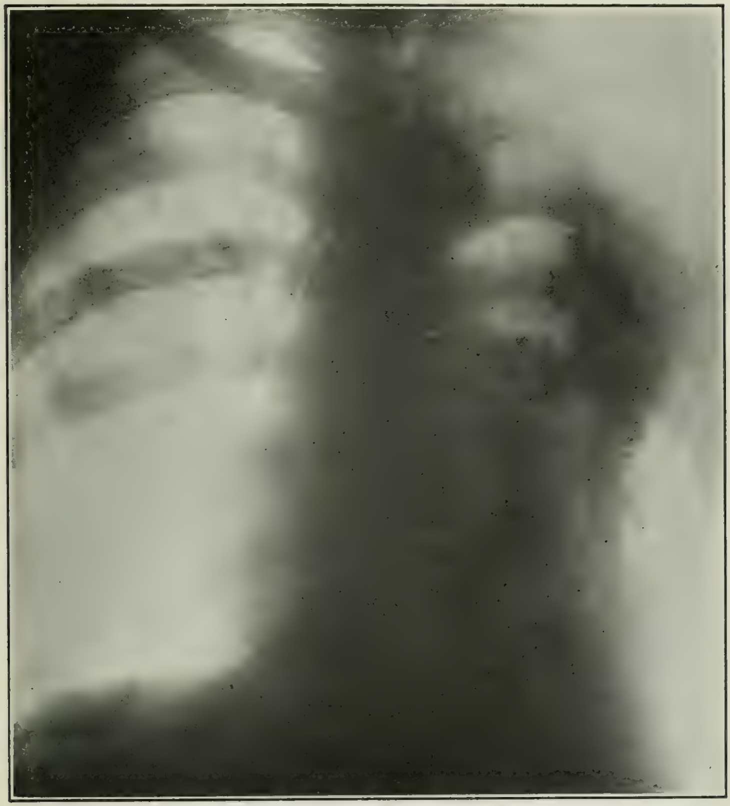
The following five cases (I have not included cases operated upon or treated by my assistants) illustrate the points I have tried to make and constitute my experience in the chronic condition—with the exception of three other cases, in one of which there is a tuberculosis of the lung, in another a large cavity was lined with a thick shell of bone, and in the third an extensive plastic operation had been done and a long narrow sinus remained. The tuberculous case is still under treatment with a regularly diminishing cavity, the calcareous case died two months after an extensive plastic operation, and the third case has disappeared.

This experience is not large, but owing to the better treatment of acute empyema one does not see so many of the chronic cases. I feel, however, that it is large enough to show that we have in this treatment—which originated in the war—the best method of dealing with the chronic empyema of civil life, and that it should be conscientiously tried before resort is had to the formidable and mutilating plastic operations.

Before undertaking the treatment I think that one should familiarize himself with the details of the Carrel technic. In the beginning failure is sure to be met; the one failure and the repeated delays in my own experience have been due I am sure to my own faults in technic already referred to.

Case I.—C. B. W., aged thirty-eight years. Pennsylvania Hospital. This patient came under my care March 29, 1919. In May, 1918, he had a pneumonia followed by an empyema, which "pointed" in the interspace just below the left nipple and was simply incised by his physician. Since this time he has had more or less continuous drainage and fever. As soon as the sinus closed the patient expectorated pus, but this stopped when the sinus opened again. The pus from the cavity shows streptococci, staphylococci and pneumococci. The sinus was injected with bismuth and oil and excellent stereoscopic plates were made by Dr. Manges. The outline of the cavity is irregular and extended posteriorly up under the scapula and as far down as the tenth rib. The communication with the bronchus is also shown in the plates. After this examination the patient coughed up at once a considerable amount of bismuth and oil. The empyema was evidently of the interlobar type. Under gas anesthesia a portion of the sixth rib and its cartilage, both of which were diseased, was removed and the sinus dilated until it admitted a finger easily. Considerable bismuth and oil were evacuated and two tubes were introduced. The Carrel-Dakin treatment was begun three or four days after the operation and the patient was discharged from the hospital on May 5th. At this time there were still organisms in the smears but the patient was much improved. From this time until his complete cure the

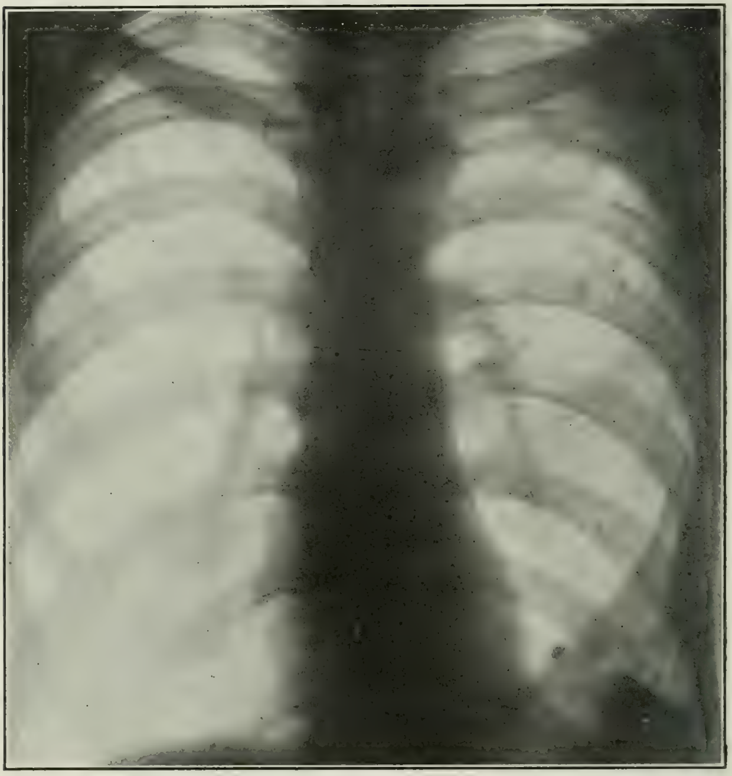
treatment was carried out at his home by his wife, the Dakin's solution being obtained fresh from the hospital every two or three days and the patient reporting once a week. The sinus closed in August but reopened in September; it closed again after a week or



Case I.—March 7, 1919.

two weeks and has remained closed ever since. The patient gained about forty pounds in weight during the course of his treatment and carried on his work, that of manager of a large farm. Recent examination shows perfect function with complete expansion of the lung and these findings are confirmed by a roentgen-ray plate.

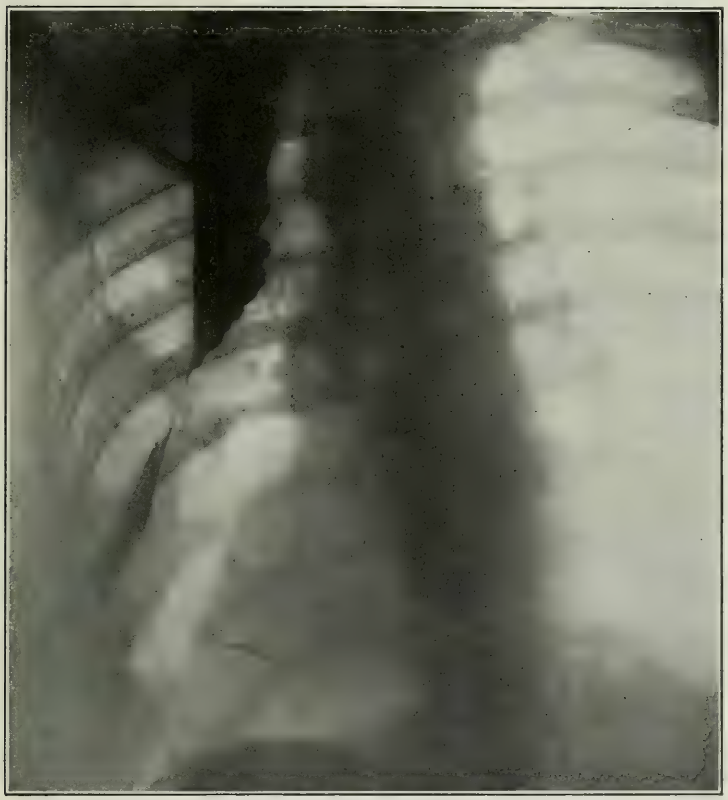
Case II.—W. R. L., aged thirty-five years. Pennsylvania Hospital. This patient came under my care April 7, 1919. He had an empyema which had been drained with rib resection in September, 1918, in another hospital. The empyema had developed insidiously the previous May. Drainage has kept up ever since operation



Case I.—April 26, 1920. Wound closed since September, 1919. (See page 32.)

and the patient has fever off and on. Injection of the cavity and roentgen-ray plates showed it to be very large and to extend posteriorly as high as the second rib. It was evidently of the interlobar type. He was admitted to the hospital, April 14, 1919, the sinus was dilated without an anesthetic, bismuth, oil and pus evacuated, and the Carrel-Dakin treatment started. After about three weeks he went

home, where a sister, who was a trained nurse, carried out the treatment. The sinus in this case was four and one-half inches long and the length of the cavity three inches. A catheter was employed for the instillation of the fluid. The sinus closed in September and has remained closed since and there is good expansion of



Case II.—April 15, 1919. Patient on right side.

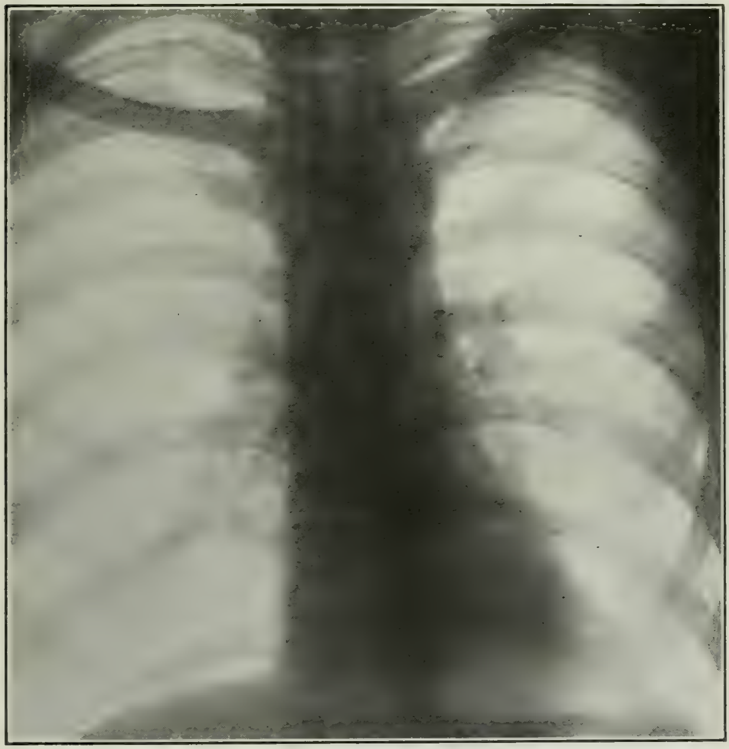
the lung. Patient gained about ten pounds in weight and went back to work in July. In this case the opening of the sinus was far below the cavity, but the patient was made to keep the recumbent position after each instillation of the fluid and the tightness of the sinus about the catheter tended to prevent the escape of the solution. His chest appears normal on physical and roentgen-ray examination.

Case III.—W. W., aged forty-four years. Pennsylvania Hospital. This man was operated upon for empyema on December 4, 1918, by Dr. Stewart. An intercostal incision was made and a double tube inserted. Dakin's solution was employed for a short

Case II.—April 15, 1919. Patient on back. (See page 34.)

time. He was discharged March 16, 1919, still draining. He was readmitted on May 16th, when another incision was made to give better drainage. He was discharged on the 25th much improved. He was admitted to my service November 12th, about a year after his first operation. He had fever and a discharging sinus. The

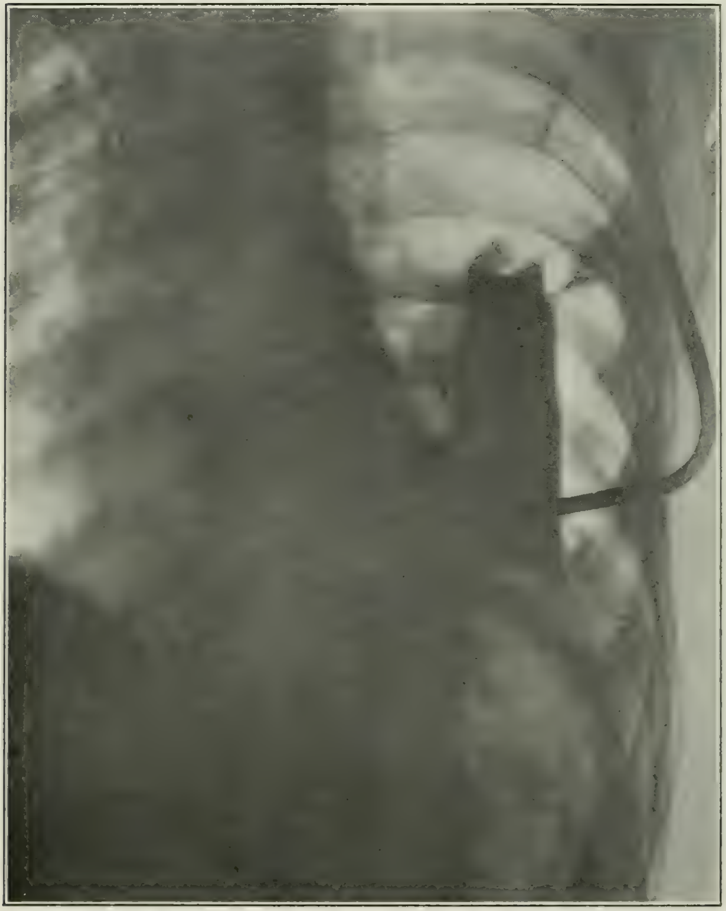
plates showed quite a large cavity containing six to eight ounces of fluid. Carrel-Dakin treatment was commenced, and as smears were negative on three occasions the sinus was closed on December 24th, about six weeks after the commencement of the treatment. It remained closed for about a month when he was readmitted with



Case II.—April 20, 1920. Wound closed since September, 1919. (See page 34.)

fever and the physical signs of fluid. His condition immediately improved and the cavity began to grow rapidly less under the Carrel-Dakin treatment. Since this time closure has taken place twice, but each time has been followed by a reaccumulation of pus. For the last six or eight months the man has been at work. This case represents a failure thus far, but I believe if the patient were

kept on his back the cavity could be readily sterilized. The patient is loath to give up his work and his general health has improved so much that I have not insisted upon the necessary rest.



CASE III.—November 3, 1919. (See page 36.)

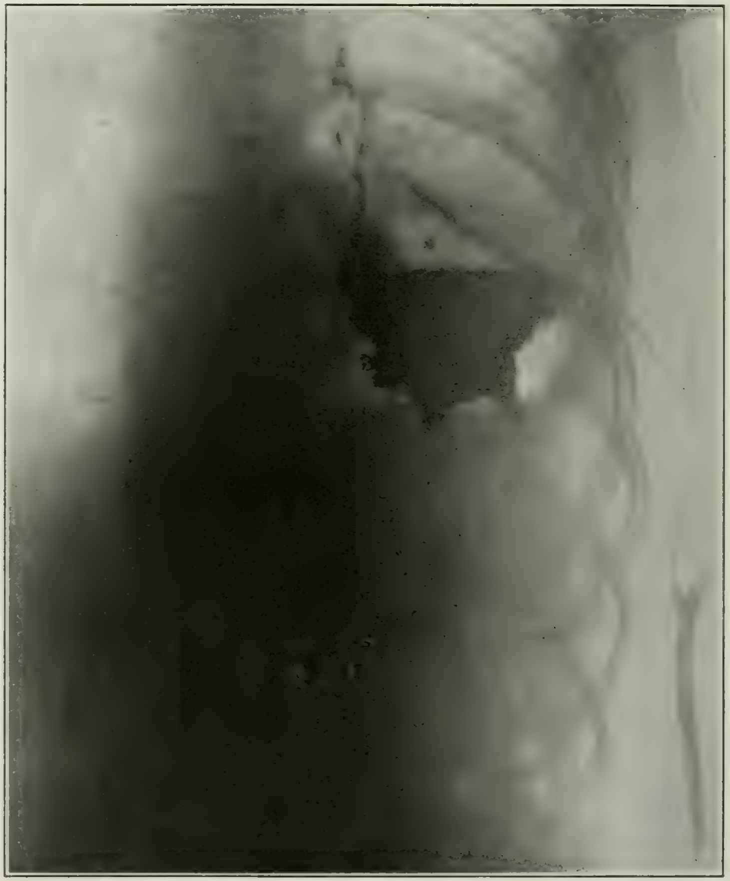
CASE IV.—P. P., aged thirty-four years. Pennsylvania Hospital. This man was operated upon in another hospital March 6, 1920, for an empyema following pneumonia. A rib section and drainage was done. The sinus has remained open ever since. He

came into my service on September 13, 1920, six months after his operation. Roentgen-ray plates showed a large cavity. Carrel-Dakin treatment was started and fairly prompt sterilization was accomplished, the patient being discharged with the sinus closed on October 25. It has never reopened and the patient has been perfectly

Case III.—March 25, 1921. (See page 36.)

well and now has full expansion of the lung, but his roentgen-ray plate shows considerable bismuth in the lower part of the cavity. I regret that we did not get rid of all the bismuth in this case. However, he demonstrates a quick and complete cure in a chronic condition.

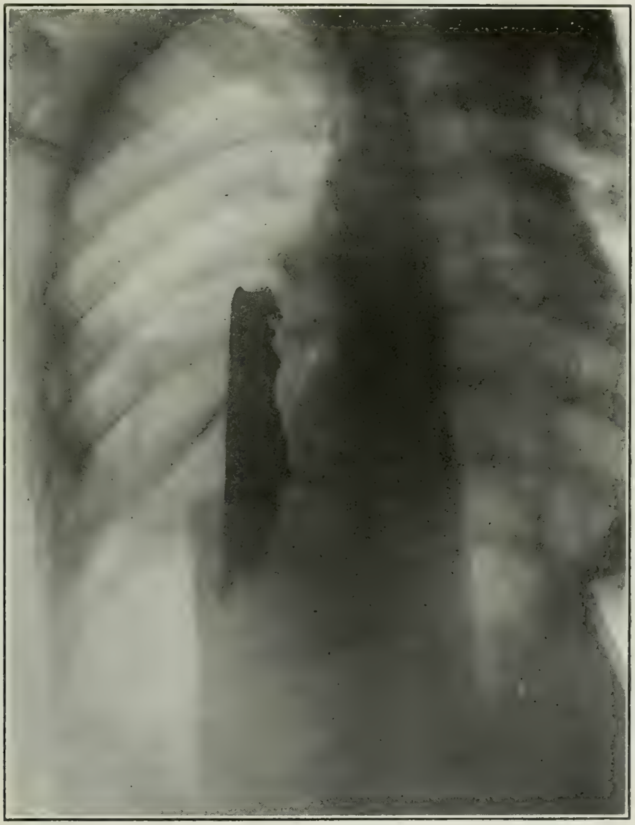
Case V.—E. S., aged eighteen years. Jefferson Hospital. This boy was operated upon for empyema in a neighboring town in 1912. Several ribs were resected. He was in the hospital seven months and was discharged cured, the wound being entirely healed.



Case IV.—September 14, 1920. Patient erect. (See page 38.)

He had no trouble for seven years (August, 1920), when a small fragment of bone was discharged. At this time he was admitted to the Pennsylvania Hospital and operated upon by Dr. Mitchell for a necrosis of the third, fourth, fifth and sixth ribs. The sinus

was curetted and injected with Lassar's paste. Later a counter-opening was made lower down. He was discharged from the hospital on October 9, the sinus being entirely healed. In January, 1921, the upper sinus reopened. He was admitted at this time to



Case IV.—September 14, 1920. Patient on side. (See page 38.)

the Jefferson Hospital, where a roentgen-ray examination showed a body of bismuth about the middle of the chest and a smaller portion quite low down near the diaphragm. This bismuth had evidently remained in the chest since last August. When the sinus was injected with bismuth and oil, it was found to communicate with the

old bismuth shadow below and there was apparently no communication with that above. The lower cavity was quite large, holding several ounces and communicated with the opening in the chest-wall by a very narrow sinus. There was a fusion of several ribs at the site of the former operations. On February 1, I increased the size of the opening, removing some bone with forceps, dilated the tract and evacuated considerable bismuth and oil. Long curved forceps passed down through the sinus could be felt quite readily

Case IV.—January 7, 1921. Wound closed since October, 1920. (See page 38.)

between the ribs six inches below. A Carrel tube and catheter were inserted into the cavity and the Carrel-Dakin treatment started the second day after operation. There was considerable discharge of pus for the first ten days, but has nearly altogether disappeared. The patient is still in the hospital. (Patient developed scarlet fever during his convalescence and treatment was interrupted. Later it was recommenced, and on discharge, April 29, 1921, the wound was closed.)

To summarize these cases, the first two represent cures after a number of months of home treatment, in one of which there was a bronchial fistula; the third case represents a failure so far, although closure has taken place twice; the fourth case represents a prompt sterilization with permanent closure and the fifth case a cure.

Case V.—January 19, 1921. Wound closed April, 29, 1921.

DISCUSSION

Dr. John B. Roberts: The paper of Dr. Gibbon conveys a very important lesson. My experience with chronic empyema has been for the most part obtained from cases not associated with war injury. Many years ago, scarcely more than a few months from my graduation, I was put in charge, at a hospital, of a gunshot wound of the lung which caused empyema. Simple tapping, a drainage tube thrust between the ribs

and daily irrigation with carbolic acid solution resulted in sterilization and healing of the thoracic opening in a few weeks. Ever since that experience I have treated a fair number of cases in infants and adults, nearly always without resecting a rib. Acute cases occasionally recover without irrigation if the tube is removed early. As a rule, irrigation becomes necessary and is indicated by the temperature curve. I believe the drainage tube is often left in too long. I am not sure that Dakin's solution is superior to carbolic acid as an irrigating antiseptic. Carbolic acid is valuable in watery solution. It does not irritate the skin around the incision made for drainage. If the pleural sac after thorough irrigation is nearly emptied of the antiseptic wash by turning the patient upside down over the edge of the bed there is little risk of phenol poisoning. The urine will become smoky when the carbolic acid is absorbed to an extent to be toxic. This must be carefully guarded against. I would start daily washing with about 0.25 per cent solution of the phenol in water and leave scarcely any within the pleural sac. This strength may readily be modified if it be found to cause dark urine, or increased if disinfection is not soon accomplished.

SOME OXIDATIVE MECHANISMS IN LIVING TISSUES.[1]

By F. GOWLAND HOPKINS, M.B.
PROFESSOR OF BIOCHEMISTRY IN THE UNIVERSITY OF CAMBRIDGE, ENGLAND.

I SHOULD like first to acknowledge very gratefully the high honor your College has done me in allowing me to speak within the walls of this great institution. I fear that to many in this audience what I have to say may appear remote from clinical interest; but it was as a biochemist that I was invited to address you, and in that capacity I must speak.

I am to deal with the oxidations which occur during the processes of life. This is a very big subject and you will agree that I must limit what I have to say to certain aspects of it. The particular facts which I have selected for discussion may seem overtechnical to those not accustomed to think as chemists, but they involve considerations which are to a large extent new and, I think, suggestive. For this reason I was tempted to select them.

The problem presented by the oxidations which occur in living matter is, of course, not new to science. It is, and always was, one of the central problems of biochemistry. It may be stated thus: Living tissues receive from the blood materials derived from food which they ultimately oxidize; they also receive a supply of oxygen. The oxygen, however, is molecular oxygen, which at the temperature of the body does not oxidize the materials in question. How then are such biological oxidations brought about?

You would not expect a complete explanation to arrive on very simple lines. The tissues oxidize diverse substances, and

[1] Read April 6, 1921.

pathology shows that different materials require diverse mechanisms for their oxidation. The diabetic organism, while able to burn many substances quite freely, is apparently less able to burn sugar. The alkaptonuric organism lacks, on the other hand, a quite different oxidative mechanism. It burns sugar normally but it fails to burn completely a part of the protein supplied to it. Other abnormal conditions seem to involve rather a loss of the full ability to oxidize fats. Instances might be multiplied, but those mentioned will be sufficient to emphasize the fact that a living tissue has at its command more than one form of chemical machinery to secure the occurrence of oxidations. I am to discuss one particular form alone.

We have good reason to believe that the living cell proceeds, in certain cases, to modify the substances supplied to it in such a way that material which in its original form resists the attack of molecular oxygen is converted into material which no longer resists it. We speak of the latter as auto-oxidizable material. In such cases what we agree to call anaërobic changes precede and prepare the way for oxidations. It is important to realize, however, that other anaërobic processes in the living cell may themselves involve actual oxidations. The cell may oxidize certain materials even when no free oxygen is available. It is of great interest to know that the reason for this is the presence of factors which make possible the utilization of the oxygen contained in water. Water, after all, is quantitatively the most prominent constituent of living matter and is perhaps the most important of biochemical reagents. Oxidations which follow upon the transfer of oxygen from water are especially conditioned. They call (at any rate when they occur at the temperature of the body and in the circumstances proper to living tissues) for special catalytic agents; but they require also the presence of a *tertium quid*. Reduction must occur simultaneously with oxidation when the latter is of the kind under discussion, so that a reducible as well as an oxidizable substance must be present in the system. It is customary—and it is very convenient—to speak of the substance which becomes oxidized as the "oxygen

acceptor" and of that which becomes reduced as the "hydrogen acceptor." There is nothing really exceptional about this simultaneity of oxidation and reduction. If you think of it, whenever in course of chemical change a substance is oxidized, another substance is always at the same time reduced. What is special about the case we are dealing with is the fact that both processes depend upon the elements of water. Such "hydrolytic oxidation-reduction processes" (as they have been called by Bach) may proceed under the influence of metals of the platinum group as catalysts. But living tissues contain catalysts which have a precisely similar action. One such is present in milk. It has been familiar for some years and is known as Schardinger's ferment. Fresh milk does not by itself decolorize methylene blue, but if aldehyde be added to the milk at the same time as the dye the latter is promptly decolorized. If the aldehyde is present alone it is not affected by milk, but in the presence of methylene blue it is quickly oxidized. Decolorization of methylene blue is a reduction process, and it is seen that under the influence of the milk catalyst the dye acts as a hydrogen acceptor and the aldehyde as an oxygen acceptor. Both, as we have seen, must be present, as well as the catalyst, to establish the active system. The point of significance in connection with the subject of this address is that in this active system the aldehyde is oxidized without the intervention of free oxygen. Substances more resistant than aldehyde may suffer oxidation under similar conditions. E. J. Morgan and I, for instance, have recently found that the purin bases, xanthin and hypoxanthin, are rapidly oxidized to uric acid when they are added to fresh milk containing a little methylene blue! Living tissues contain catalysts with an action precisely akin to that of Schardinger's enzyme and can bring about oxidations of exactly the same kind.

The kind of chemical change which we have just considered involves the simultaneous activation of hydrogen and oxygen originally present in the molecule of water. It seems, however, as though, in certain cases at least, the living cell can activate and remove hydrogen atoms present in the molecule itself of the

substance to be oxidized without the immediate intervention of oxygen from any source. If hydrogen be removed from a molecule the result is one which we should call an oxidation even though oxygen has not actually intervened. Consider two cases.

I have already spoken of the oxidation of aldehyde in aqueous solution as occurring in the absence of free oxygen so long as a hydrogen acceptor such as methylene blue is present. We can picture the process (avoiding details) thus:

$$\mathrm{CH_3\,COH} \longleftarrow \mathrm{O.H_2} \longrightarrow \text{methylene blue} =$$
$$\mathrm{CH_3\,COOH} + \text{methylene blue} = \mathrm{H_2}\ \text{(methylene white)}.$$

Viewed in this way the case seems to present a clear instance of the intervention of water. But we also find cases of another type. Succinic acid, for instance, is oxidized by living tissues to fumaric acid.

$$\mathrm{CCOH.\,CH_2.\,CH_2.\,COOH} \longrightarrow \mathrm{COCH.CH = CH.\,CCOH} + \mathrm{H_2}.$$

Here so long as an acceptor for the hydrogen is present the oxidation occurs in the absence of any source of oxygen. The case may be one of hydrogen transport simply, though we may still speak of simultaneous oxidation and reduction, for the succinic acid is "oxydized" and the hydrogen acceptor (whatever it may be) is "reduced." It may be that these two cases are not essentially different, for we might (with Wieland) consider the first to depend, not upon the dissociation of water, but upon the preliminary formation of aldehyde-hydrate from which oxygen is then removed.

$$\mathrm{CH_3CH}\begin{array}{l}\diagup \mathrm{OH}\\ \diagdown \mathrm{OH}\end{array} \longrightarrow \mathrm{CH_3\,COOH} + \mathrm{H_2}.$$

In any case the conception of catalytic systems concerned with the activation and transport of hydrogen, even if it has limited applications in connection with the total oxidative activities of the living cell, is undoubtedly significant and important. To understand it fully it should be clearly realized that the ultimate fate of the transported hydrogen may be oxidation by molecular

oxygen as supplied to the tissues from the blood. The hydrogen once mobilized, so to speak, may be directly oxidized, or it may be transferred from a compound which is not auto-oxidizable (in the sense already defined) to another compound which, having taken up the hydrogen, becomes auto-oxidizable. We may say, if you will, that hydrogen is then transported from a position in which it is not "active" toward oxygen to another position in which it is active.

I have put these particular facts before you because they prepare the way for the statement of certain other facts which are new to the subject.

Many years ago a French author, Rey de Pailhade, brought forward a proof that living tissues do, as a matter of fact, contain active hydrogen, though he has never shown in what compound it is present. A late writer, A. Heffter, has, on theoretical grounds, suggested that this hydrogen might prove to be present in combination with sulphur.

The sulphydryl group, –SH, when it occurs in organic substances, is generally auto-oxidizable. When a compound, X–SH, is exposed to the air under right conditions the hydrogen it carries is oxidized and a disulphide linkage is established, thus:

$$4(X-SH) + O_2 = 2(X-S-S-X) + 2H_2O.$$

If then the tissues contain such a compound, part of their oxygen uptake will be concerned with the oxidation of the –SH group. If at the same time they contain a mechanism for the transference of hydrogen from other compounds (not auto-oxidizable by themselves) to the resultant –S–S– group, so that this is again reduced to –SH– (–reduction keeping pace with oxidation–) a dynamic system will be established, securing the oxidation of substances which are not spontaneously oxidizable.

It has been my fortune recently to separate from animal and vegetable tissues a substance of which the constitution and properties render actual the suppositions just put forward. The substance is a dipeptide. It consists, that is to say, of two amino-acids linked together. Of these one is glutamic acid and

the other cystein, the latter carrying, of course, the –SH group. Under the conditions proper to living tissues the hydrogen of this group is oxidized spontaneously by atmospheric oxygen. The significance of this fact is greatly increased by the proof, which is easy to obtain, that the tissues have the power of reducing the substance afresh whenever it has once assumed the oxidized form. The –SH group is oxidized to yield the –S–S– group and the latter again reduced to the former. The process must be continuous so long as there is a supply of hydrogen capable of transference on these lines. The properties of the dipeptide may be simply demonstrated by use of methylene-blue reduction, in which, of course, the dye (instead of oxygen) becomes the final hydrogen acceptor.

Tissues when freshly removed from the body actively reduce (decolorize) methylene blue. If, however, a tissue after subdivision be thoroughly washed with water, a treatment which results in the removal of the dipeptide of which I am speaking (of course with other constituents as well), this power of reduction is lost or greatly diminished. If, however, to such washed tissue a small quantity of the dipeptide, in its oxidized form, be supplied, the reducing power is restored. Yet in this oxidized form the dipeptide has no reducing power of its own. The washed tissue, by itself, can reduce the dye at most very slowly, and, by itself, the oxidized dipeptide cannot reduce it at all; yet together they reduce with relatively great velocity. This is because the washed tissue still contains the factors which reduce the dipeptide, and once the latter is reduced it promptly reduces the methylene blue. Thus two reactions, (1) the transference of hydrogen to the –S–S– group, and (2) its transference from –SH group to the dyestuff, go faster (much faster) than the single reaction involved in the direct transfer of hydrogen from the tissue to the dye. The dipeptide therefore acts as a catalyst; probably as coagent with an enzyme which first mobilizes hydrogen on the lines which were earlier discussed.

This dipeptide is widely distributed in nature. It seems to be present in all tissues, animal and vegetable, in which active

metabolism occurs. I have actually separated it from sources as diverse as the yeast cell and mammalian muscle and liver; but I rely for the above statement on the almost universal occurrence of a color reaction with nitroprusside of sodium, due to the –SH group, the use of which led Heffter to suggest some years ago that a compound containing this group must be present in living tissues. In the particular tissues just mentioned the dipeptide is certainly responsible for this color reaction and there is a great probability that it is the substance which gives it in the case of other tissues or cells.

The chief point of interest (as it seems to me) in what I have been able to tell you is the circumstance that we can now handle objectively a definite tissue constituent with dynamic functions. Whatever the limitations of its activity this dipeptide certainly plays some definite part in the promotion of biological oxidations.

DISCUSSION

Dr. A. N. Richards: I welcome very much the opportunity to discuss Prof. Hopkins's paper, not that anything can be added to it. When anyone can bring before us a crystalline constituent capable of synthesis from a living cell, which is able to carry on the processes which hitherto we have believed to be vital processes unexplainable by the ordinary laws of physiological chemistry, and when the person who tells us about this is the one who has discovered it, it seems to me that we have had a memorable evening.

Dr. G. H. Meeker: Prof. Richards has paid a just tribute to the work of Prof. Hopkins. I am happy to have the opportunity to supplement what Prof. Richards has said—not as a contribution to the subject-matter of the evening, but rather as an appreciation of the important results which Prof. Hopkins has laid before us.

It appears to me that we have in the work of Prof. Hopkins the latest of a series of four epochal announcements which have been bringing us gradually toward the elucidation of the precise nature of biochemic changes.

The first step in the series was taken by Pasteur, about 1857, when

he clearly proved, against the lively and historical opposition of Liebig, who represented the older views, that the chemical processes of fermentation were not, as Liebig insisted, due to the spontaneous "contact action" of the proteins present, but were really the result of the life processes of microörganisms which were also present during the fermentation.

The next step in the series was furnished forty years later, in 1897, by Buchner, who then announced that he had separated a certain nonliving substance, zymase, from yeast, and that zymase was capable of producing the alcoholic fermentation which is so characteristic of the life history of yeast. In other words, fermentation can proceed in the entire absence of life—requiring only the presence of certain lifeless substances, enzymic in nature, which are products of metabolism in microörganisms.

But what is an enzyme, and by what chemic mechanism does it act? It was obvious that this problem was linked with the problem of the chemic nature of proteins.

The third step in the series was due to Emil Fischer, who not only showed that proteins break down into aminoacids and but who also showed, about 1901, how aminoacids could be joined together so as to synthesize those protein substances which are now known as polypeptides.

From Prof. Hopkins comes, twenty years later, an announcement of the nature of the chemic mechanism, whereby certain, at least, of the polypeptides act as enzymes, and induce those intracellular oxidations (and reductions) which are so characteristic of the chemical processes of life. Thus we have, in 1921, the fourth and latest step in this notable series of chemic achievements, and we who are here tonight may well feel the same sense of gratification that they must have felt who were fortunate enough to learn of Pasteur's epochal discoveries from his own lips.

THE VALUE TO THE COMMUNITY OF ORGANIZED EFFORT TO CONTROL HEART DISEASES[1]

By LEWIS A. CONNER, M.D.
NEW YORK

First of all I should like permission to express my great interest in and sympathy with this institution that the citizens of Philadelphia have established on their public health day and to express my appreciation of the privilege of joining them in this celebration. To most physicians, and I think to most laymen, the idea of including diseases of the heart as among that group of preventable diseases that communities feel under an obligation to protect themselves from, or at least to control and diminish if possible, I say to most people the idea of including diseases of the heart in that group would appear, to say the least, novel and perhaps chimerical.

Communities have, of course, for a very long time protected themselves from the epidemic plagues and from the more familiar contagious epidemic diseases such as scarlet fever, diphtheria and typhoid fever. More recently they have come to realize an obligation to protect the individual from communicable diseases that were not epidemic in character, such as tuberculosis and venereal diseases; but only very recently have communities come to feel an obligation to direct concerted action against diseases which are not communicable but which are, nevertheless, preventable, and it is as the result of the awakening of the public conscience with respect to public health matters that we see established such organizations as those designed for the prevention of industrial diseases, the prevention of blindness or the improvement of mental and child hygiene, for the control of cancer and so on.

[1] Read May 4, 1921.

Does heart disease come within this group of diseases which the community should make a concerted effort to combat? To answer that in the affirmative will require, I think, first of all, that it be shown that heart disease is sufficiently important in its social and economical effects to justify such special consideration, and, second, assuming that it is sufficiently important, that the existing methods of dealing with it are not sufficiently satisfactory to make it wise to leave the matter as it is.

It is my purpose at this time to try to furnish you with some facts bearing on both these points, with the hope that you will then be able to answer that question for yourselves as to whether heart disease really deserves to be classed as a public health disease, if I may use such term.

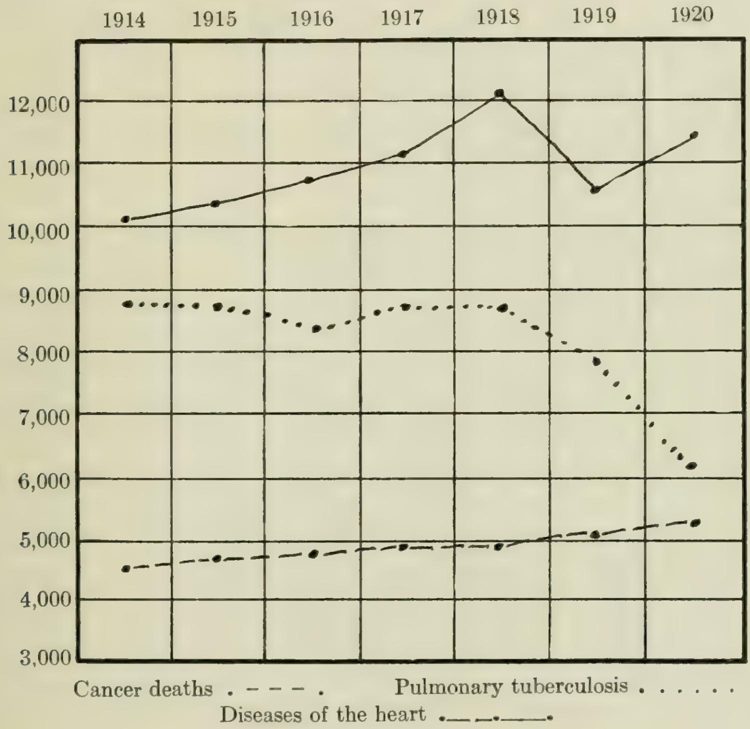
Now, first of all, about its prevalence and frequency: As to mortality I have two charts here which give some idea as to that.

DEATHS IN THE UNITED STATES REGISTRATION AREA DURING 1917

	All ages.		Ages, forty and over.		
	Number.	Per cent of all causes.	Number.	Per cent of all causes.	Per cent of all ages.
All causes	1,066,711	100.0	566,323	100.0	55.0
Pulmonary tuberculosis	93,290	8.7	35,151	6.0	37.7
Cancer	61,429	5.8	55,929	9.5	91.0
Cerebral hemorrhage and apoplexy	62,417	5.9	59,822	10.2	95.8
Lobar pneumonia	74,577	7.0	43,236	7.4	58.0
Kidney disease	82,657	7.7	70,725	12.1	85.6
Heart disease	128,719	12.1	110,426	18.8	85.8

Here is a table of deaths in the United States registration area during 1917, which shows the relative frequency of deaths from the more important diseases. In the column of deaths of all ages it will be seen that 12 per cent, or nearly one-eighth, of the deaths are ascribed to heart disease, and that among the deaths of those of forty years and over heart disease is held responsible for nearly one-fifth of the total number. The next chart shows the comparative mortality in New York City of pulmonary tuberculosis, cancer and heart disease during the years 1914–1920 inclusive and illustrates strikingly the high mortality of heart disease.

Now as to the *incidence* of heart disease: We have no figures quite as accurate as those of mortality, but there are various ways of getting at some approximation of the incidence. The draft board examinations and the army examinations of the newly inducted men show a percentage of rejections for heart disease, or for affections of the heart, of about 4 per cent. That



is to say, among 5,000,000 men of military age, young men, 200,000 were rejected because of some heart defect. It may well be that this proportion is larger than it deserved to be, but that gives some idea of the prevalence of the condition in the class of population represented by men of military age.

Examination by school inspectors in New York of some 250,000 children showed a percentage of heart defects of 1.6, and it was

estimated that there must be approximately 20,000 children of school age in New York with heart defects of greater or less degree of gravity. Then from the tables from the insurance companies and from various other means one can get at some approximation of incidence, it is safe to say that approximately 2 per cent of the population of any community suffer from some form of heart disorder or some organic disease. So in a population of 1,000,000 we would have 20,000 people or thereabouts with some form of heart disease. But the importance of heart disease to a community is shown not only by the impressive figures concerning its incidence and its mortality but also by the serious disabling effects to those who are the victims of its more chronic forms.

Most people with organic heart disease are crippled to some extent—their economic importance is lessened, and in a large proportion of cases is seriously lessened. In those with the more advanced forms their economic value is lost entirely and most of them are wholly dependent upon their families or upon the public charities of the community. So that the economic question in heart disease is really a very serious one.

It still remains to be shown that the present methods dealing with heart disease are not as satisfactory as they might be and that something may be gained by an organized effort upon the part of the community to improve these methods, and in my attempt to show that I will simply relate some of the experiences of such an organized effort in a neighboring community where we have been trying to work out the methods of prevention and to improve the methods of relief of this disease. The history of the heart movement in New York City is a record of a gradual development—gradual evolution of a comprehensive plan which started from very small beginning—of an attempt to relieve one special group of cases. Ten or twelve years ago it seemed rather suddenly to strike several groups of hospital physicians and social service workers in different parts of the city about the same time that there was a shocking waste of health and life going on right under their eyes in the behavior of these workingmen who came to the

hospital wards with a heart breakdown, who under treatment in the wards of a few weeks recovered their health apparently entirely, seemed to be about as well as they ever were and went out with the admonition to avoid the heavy work that they had been doing and to find some light work. These cases never found the light work. They knew only one trade, as a rule, and they could get a living wage at their occupation—longshoremen, hod-carriers, truck drivers and what not—and they always went back to that trade, and within a few weeks came back to the hospital in the same dreadful plight as before. The second time they did not recover so quickly as before, and that happened several times, and so in a year or two the breakdown was complete.

It was the effort to relieve that rather small group of heart cases that started this movement in New York City. The first constructive effort to deal with such cases came in the establishment in the Bellevue Hospital out-patient department of a special heart class under the direction of Dr. Guile. I think it was due to the very sound principles upon which that modest little clinic was started that we owe most of our progress in dealing with the heart problem. The clinic was made to take care of just this very class I have spoken of, workingmen who had had a breakdown, had been treated in the hospital and were about to be discharged. They were sent to this clinic, which was organized so as to have the help of the social service worker who could watch these men; could go to their homes and educate them and their families in their limitations; could go to the workshops and investigate the work they were doing; could go to their homes and bring them back to the clinics for regular monthly or bi-weekly examinations; and the success of the clinic rested very largely upon this social service side of it. The clinic was held in the evening in order that the workingmen could come without loss of time, and they even went so far as to hold it on Friday evening, reasoning that these men would come back with signs of beginning breakdown once in a while, and if they could be sent home to bed for two days—Saturday and Sunday—they could get these two days in bed with the loss of only a half-day's wages.

The success of that dispensary clinic in the course of a year or two was very palpable, and that has formed the basis of all the cardiac clinics that have since been formed throughout the city. About the same time some of those interested in this matter began to work in quite a different direction. It was realized that what these men needed was a long period of convalescence after leaving the hospital before they went back to work, and it was felt that if during the long period of convalescence they could be taught some sedentary trade which would enable them to support their families and themselves without returning to their old trade, which had been largely responsible for their breakdown, there might be some chance of maintaining them as wageearners. So a small convalescent home was established for this purpose at Sharon, Conn. This you sometimes hear spoken of as the Sharon experiment. We had these men go up for several months. It was only for the workingmen. During that time they were taught a sedentary trade. While that experiment showed certain defects in that plan it went a long way toward opening the doors of convalescent homes, which up to that time had been closed against heart patients to them. It was found that these men under reasonable supervision could work almost all day. They could go on working day after day and week after week, and they did that when they came back to New York and took up their new trade. And while that was an expensive way of dealing with the problem it served its purpose. It was an experiment, but it served the purpose of teaching the convalescent homes that they could take the heart patients and could accomplish quite as much with them as with other forms of individuals who needed convalescent care.

These two lines, then, were the beginning of the heart movement in New York, and one could not get interested in these aspects without seeing the possibilities of good in other directions—the care of the children, the efforts at prevention—so that after two or three years it became evident that some organization was needed which would take up in a comprehensive way the interests and the welfare of the whole class of heart patients, and so was organized the Association for the Prevention and Relief of Heart Diseases.

That started in 1916 and had got well under way when the war came along and interrupted its activities for two years; but it was then taken up again in the fall of 1919 and has since gone on.

The purpose of that organization was not so much to do actual heart work itself as to utilize all existing agencies for the care of these heart patients, and. indeed, it was a coördinating organization, an organization for propaganda rather than actual work with the individual patients. The central office was established, an executive secretary was secured and the first efforts were made in the direction of increasing these dispensary heart clinics which the Bellevue clinic had shown to be so very effective in dealing with these cases, and these clinics gradually sprang up in the different hospitals throughout the city. Some of them were devoted to children solely, some for adults, some for workingmen, some were held in the afternoon and some at night. That and the effort to increase the convalescent facilities were the particular lines on which the organization worked during the first year or two.

It was felt from the beginning that it ought to make an effort to wrestle with the problem of prevention. While it did not seem possible to accomplish much in this direction at first, it nevertheless has been constantly in the minds of the Governors of the Association that prevention, in its broader sense, was the goal to be striven for. Efforts at prevention, in heart disease, may be directed not only toward the disease itself but toward the tendency, in certain types of cases, to the recurring attacks of inflammation, which are so frequent and so serious, and toward the tendency to functional breakdown in hearts already damaged.

Now just a word about the types of diseases in connection with this matter of prevention. For our purposes the organic diseases can be roughly grouped into three great classes: Rheumatic diseases, found chiefly in childhood and adolescence; then a second group of syphilitic diseases of the heart seen chiefly in the middle years of life; and, finally, the group that we might speak of as the degenerative cases, those occurring in the later years of life and including a somewhat miscellaneous group.

In the matter of prevention it has been possible to accomplish

something so far as the rheumatic type is concerned. The prevention of rheumatic heart disease is the prevention of rheumatic infection, and the prevention of that depends in large part upon the prevention of tonsillitis and throat infections, and to a less extent the inflammation of adenoids and diseased teeth and so on. Of these the tonsils are certainly far and away the most important, and we have attempted to work in this direction of prevention by the education of the physician, the education of parents and of school-teachers in this relationship between tonsillitis and throat infections and rheumatic infections. We have emphasized the need of careful treatment of all such infections: such as attacks of tonsillitis; of keeping the children in bed until they are thoroughly over it; of a period of relatively long convalescence; of the inclusion in the heart clinics of the so-called potential cases (children who have had frequent attacks of tonsillitis, rheumatism or chorea) and of watching the care of their throats; the removal of diseased tonsils; cleaning up of teeth; removal of adenoids and the improvement of the convalescent facilities for such children.

The value of tonsillectomy as a measure of prevention of rheumatic infection is still uncertain, but that it is of some value can hardly be doubted. The recent careful statistical study[1] by Dr. St. Lawrence, from St. Luke's Hospital children's cardiac clinic, furnishes some weighty evidence in support of this view. While his figures are not large the work has been done so carefully and the periods of observation of the children, both before and after tonsillectomy, have been so long that it is the most valuable contribution to the subject with which I am familiar.

At present we have in this city some fifteen children's heart clinics, and in these fifteen there are some 2200 cases that are classed as in active attendance. I cannot but believe, where they are looking after over 2000 children, that a good deal of good must be accomplished in the way of prevention by their attendance and care at the dispensary clinic, particularly in what may be

[1] Effect of Tonsillectomy on the Recurrence of Acute Rheumatic Fever and Chorea, Jour. Am. Med. Assn., 1920, v. 75, 1035.

spoken of as the potential heart cases, children who have had varied rheumatic manifestations, but up to the present time have escaped involvement of the heart.

In the case of the syphilitic type something has been accomplished, although I think not nearly so much as in the case of the rheumatic type. We have made an effort to emphasize by educational work the very great frequency of involvement of the heart and aorta in this disease, the importance of examination of the heart and vessels in the syphilis clinics, and the need of educating physicians generally to the vast importance of these late heart conditions in patients with syphilis. Every syphilis patient is a potential heart one, and there seems to be a crying need for the emphasis of that among the profession generally. It is astonishing how little it is appreciated. By watching these patients in the heart clinics, by supervising or examining patients in the genitourinary clinics, something has been accomplished in the way of prevention in this class. When it comes to the degenerative types of various sorts I cannot say that we have accomplished anything in the direction of prevention.

Now a few words about the different activities of our organization at present. The basis of the work is still these dispensary heart clinics. We have now thirty-one in the city, and they are all built upon the model of the original Bellevue Clinic. They each have their social service worker, so that their follow-up care can be adequately carried on. The patients come back even when they are well for monthly or periodic examinations, and they are followed to their workshops and their homes and everything is done possible to prevent the frequent breakdowns which such patients are so liable to have.

Very soon after these heart clinics began to be established the physicians working in them came together voluntarily for conferences concerning points relating to their organization and management, and as a result there was ultimately formed, under the auspices of the parent association, an organization known as the Associated Cardiac Clinics whose membership is composed of the clinic physicians. At these conferences the medical and

administrative problems of the clinics are discussed and a good deal has been done in the direction of uniformity and standardization. One of the important things accomplished has been the adoption of a standard classification of heart patients based on the degree of functional impairment of the heart. This classification which is now in general use in the clinics and convalescent homes is as follows:

Class I. Patients with organic heart disease who are able to carry on their *habitual* physical activity.

Class II. Patients with organic heart disease who are able to carry on *diminished* physical activity: (*a*) Slightly decreased; (*b*) greatly decreased.

Class III. Patients with organic heart disease who are unable to carry on any physical activity.

Class IV. Patients with *possible* heart disease. Those with some unusual or abnormal physical sign in the heart but with no confirmatory signs or symptoms.

Class V. Potential cases. Those who, although having no evidence of heart disease, suffer from some affection known to be an exciting cause of heart disease; such as rheumatic fever, chorea or syphilis.

The problem of the care of heart cripples in the public schools is one with which the association has concerned itself. The question as to whether such children should be segregated in separate classes and groups in which they can receive much closer supervision and greater protection is one concerning which much may be said both *pro* and *con*. An interesting experiment is now being carried on with some three hundred of the more severe heart cripples who have been segregated in special classes and schools in which they have constant medical and nursing supervision. It is hoped that by comparing the records of these children with those of similar grade of heart disease who have continued in the regular classes of the public schools a correct judgment as to the value of such segregation may be reached.

Convalescent homes will be left to Dr. Brush to speak about. We have now 325 beds for convalescent heart patients where when

we began we had none. We have done something in the way of providing suitable occupations for heart patients and are now giving consideration to the matter of vocational guidance to heart children when they come to the time when they have to take up their trades. We have done educational work in various lines, but these are matters that I have not time to speak of. Enough has been said, however, I hope, to convince you that much can be done to improve existing methods of dealing with the victims of heart disease and that much is to be hoped from greater attention to the all-important matter of prevention.

CONVALESCENT INSTITUTIONS IN THE CARE OF HEART DISEASE[1]

By FREDERIC BRUSH, M.D.
MEDICAL DIRECTOR, BURKE FOUNDATION, WHITE PLAINS, N. Y.

The recuperation of the heart diseased in country institutions has advanced so rapidly in the past five years that certain approximate standards are forming. These are of value, especially to communities that are just beginning organized health-effort in this branch. Progress has come through (*a*) the gradual overcoming of the prohibitions against cardiacs in existing homes, (*b*) the establishment of special heart-convalescent places, (*c*) broadening and elaboration of function in these various homes, and (*d*) bettered coördinations in the selections, convalescent placings and in vocational and occupational follow-up.

More uniformity and surety exist in the requirements for cardiacs than for other classes of convalescents, the needs of the latter being more ameliorated by the living, recreational and standard health-care conditions of each community, for heart patients cannot be hurried from the hospitals or their homes to get along fairly with average dispensary and private after-care. They need prolonged bed-treatment, and to be graded through country convalescence into the occupation suitable to each individual, or the equivalent *via* clinic and home direction. They require, furthermore, occasional reconvalescence and also preventive recuperations. Hence, heart-care plans for one American city will fit others measurably well, despite differences in living conditions. It is mainly this clear and stable need, readily appreciated, that is causing heart-convalescence to outgrow other kinds proportionately of late.

[1] Read May 4, 1921.

The Bed-requirement and Distribution. In the recent program for the city of Cleveland more than one-fifth of all proposed convalescent beds were given to heart disease, and in actual operation now in New York City nearly one-sixth of such beds are for this condition. In an American city of 1,000,000 population (a convenient unit) there are about 20,000 persons with heart disease. Experience so far points to a working estimate of from 3 to 5 per cent of these (600 to 1000) in need of institutional convalescence in one year, bringing a requirement of from 60 to 100 year-round beds (with an average stay of five weeks). Adopting the 100 bed-requirement the classification may be helpfully worked out by the allotment of 30 beds to adults and 70 to children from six to fifteen years old, and arranged feasibly somewhat as follows:

1. Adults of both sexes to have 30 beds in one or more general convalescent homes where some special direction is afforded.

2. A separate children's institution receiving 10 boys from 6 to 10 years old, with 25 girls aged 6 to 15.

3. Fifteen older boys (10 to 15) to be treated along with others in a general convalescent boys' home (so surely required by the community).

4. Twenty more sick cardiac children of both sexes of ages up to 15, and requiring considerable bed and reclining care at first, to have a specialized place. This plans equal provision for boys and girls—boys are generally neglected. The colored need proportionate separate convalescent opportunities.

Such ratio, *e. g.*, would give New York City from 500 to 600 beds for heart convalescents; and that this is not a fanciful nor a too ideal city plan is indicated by the rapid growth there to a present provision of over 300 beds with large extensions in prospect. Five-sixths of the 300 beds are for children, which is too high a proportion (note the two-thirds only proposed above), for while childhood, and adolescence particularly, are the proved periods for best reconstructive and preventive results, it is recognized that more adult cardiacs, and especially men under forty-five, should have readier access to such homes.

Types of Homes and Functions. Heart convalescents in institutions require regulated rest; graduated exercise; nerve and mental readjustments generally; continuation schooling, if young; full work and play-therapy; some beginning vocational guidance, and end-linking with suitable occupation and follow-up. But all of these functions are coming to be demanded of our general convalescence and are precisely adapted to it. It is a far step from the few older rest places and retreats to this new essentially American convalescent health-plant with its active tonic and formative atmosphere; and every one of these general homes (children and adult) should receive a proportion of the properly selected and prepared heart convalescents, and may be assured of average safety and success with them. The mistaken idea that cardiacs will be endangered by too active associations with other convalescents is giving way to the understanding that they tend rather to a faulty inertia and underexercise, and that they will grade almost automatically into the various upbuilding activities; and the mental and habit effects of this mixed grouping are most valuable—simulating everyday life being prepared for. We are probably in the stage of too much segregating of cardiacs. Certain special heart homes for children in the more seriously crippled classes are undoubtedly essential.

The importance of the country location with ample grounds can hardly be overestimated; it is the outdoor work, play, grade-walking, and especially the general daily activities, that must make up the major portion of the restorative and heartening exercises—influences compared with which indoor gymnastics (of assured special value) can give but scant returns.

Providing the Facilities. No one expects an ideal plan to be precisely realized in any community. Practically first must come acceptance of the idea that any scheme of cardiac care should include country convalescent outlets. Next is the getting of heart patients accepted in the existing homes and definitely planned for in those under way of development. Then will come means and sympathetic interest from various and often unexpected sources to establish new places, for children especially; and each

of these should be promptly accepted and fostered. Time and experience and the steady successes will tend to mould them into appropriate coördinated functioning.

Certain facts, kept to the fore, aid in getting and extending these desired provisions: Institutional heart convalescence has proved as safe and manageable as other kinds; demands but little medical oversight; may be well done in mixed grouping or separately; requires no new or expensive buildings and equipment, and yields results of such high order and permanence as constantly to astonish its patrons. It is an essential in any community health scheme. The costs are about one-half those of hospital care, or from $1.50 to $2 per day capita, requiring, *e. g.*, from $15,000 to $20,000 per year to run 30 beds. There is little prospect of its overextension, for the preventive phases (including prevention of heart disease incidence and of diseased heart overstrain) are undeveloped. Organization and methods are now sufficiently well standardized for adequate information to be readily available.

"Fresh-air," camping and the various recreational outlets must be counted aiding factors in the prevention and recuperation of heart disease. On the other side is the question of institutional provision for the more seriously crippled—the cardiac invalids—but this latter requires separate study and is not here included in the convalescent problem, though bordering so closely and constantly interchanging with it.

DISCUSSION OF THE PAPERS OF DRS. CONNER AND BRUSH

Dr. James E. Talley: I wish to express my indebtedness to the doctors who have given us the papers. They certainly have been most interesting. As I sat there I was thinking of our indebtedness to the laboratory. The laboratory gave us precision, two decades ago—an added stimulus in the study of heart diseases. The study of heart disease from a new angle brought up a group of men who were prepared to take advantage of the opportunity of studying heart disease from another angle, that is, the mobilization of the greatest force which the world has ever seen—

Dr. Conner in New York and Dr. Lewis in England. In this connection it has been necessary to see the same type of work carried out in the American Army, the wonderful thing it was to give these men graduated exercises in the open air, and especially games. A man came out of the hospital with only one idea, feeling perfectly unfit; his only idea was to get back to America if he could. With one or two weeks in the open his only idea was to get back to his job. We have the same problem in Philadelphia as in New York, for about one-fifth of our population have heart disease. No doubt among our school children we have the same proportion as elsewhere. We have been rather slow to take advantage of your lead. We were interested in it, but before anything was done the war broke out, and it is only in the last year that we have got started. Some fifteen of us have been meeting. We have in operation about five clinics following your lead, and the Cardiac Association is about to finish up its constitution and by-laws. We hope by another year that we will be functioning in good shape. We have the same problem with the heart patient. He always comes in and goes out because there have been no proper associations to secure him the proper job. It is a wastage of the hospital; it is needless suffering, as you pointed out, for the patient. We had convalescent homes, but this problem has never been taken up with them. The school problem, I see by your experience, is still experimental. I am sure if we get coöperation with the school authorities we will accomplish something.

Dr. Thomas McCrae: These papers have made it very evident, if any argument were needed, that proper organization is a tremendous advantage in handling any such problem as this. Many of us have been carrying on work of this kind for years in individual clinics in a spasmodic way and there is no question of the advantage of coöperation of all the hospitals in a given community. The problem falls into two parts, one of relief and the other of prevention. What was said tonight applies almost entirely to relief of the crippled individual. That is a wide problem in which a great many agencies must coöperate. The other problem is further back. How much can we do to stop the necessity for relief? In other words, how much actual prevention can we do? That problem is almost entirely in the hands of the profession. I think we must confess that is not a problem we have properly met in the past. There are two great things to be faced: rheumatic fever and throat infections. As regards rheumatic fever it was unfortunate that the designation acute articular rheumatism was given to rheumatic fever, suggesting that the articular part was essential. Were it termed acute myocardial rheumatism it would have been a term which explained what

happens to these patients. The other point in regard to throat infections need not be emphasized. What we have to do is to reduce the need for relief. In that I see one great obstacle. The greatest handicap in trying to reduce heart disease at the source is human nature both in the parents and in the patient in carrying out proper measures for prevention. A long campaign of education will be necessary.

Dr. R. Tait McKenzie: I am sure that you have, with me, rubbed your eyes in looking at some of these pictures, at what liberty has been given to some of these patients, and I feel that Dr. Brush appears before us more in the person of a priest who has given absolution to some of these patients from a course of invalidism, which is inactivity. In the great experiment in the treatment of heart cases during the war, when the men came back with all sorts of symptoms connected with the heart, there were various attempts made to classify these cases, and you may remember they were divided into various classes and given cryptic letters, like D. A. H., for disordered action of the heart, and then there were the others added, not yet diagnosed, ending up with G. O. K., God only knows. But out of these conditions I think it was Lewis who for the first time classified those that had the effort syndrome, those who had breathlessness, fatigue, palpitation and giddiness. So I believe for the first time in a large number of cases the experiment was made of giving exercises as one of the principal tests. Under the direction of Wilson and Lewis these cases were all put on definite, progressive exercise, and the power of the heart to recover to sudden exercise was thoroughly tested. I had eighty cases under my own care at that time, and as the need was great, many of these cases had to be tested rather quickly and the dosage of exercise became an important question of how much they could stand, and the dosage was usually carried up to the point where the patient either stood it or broke. That is why it seems to me so encouraging, so splendid, to see this work being carried on not in men broken by war, not by men looked upon as material to be made fit for soldiers, but in the youth, the children, and how they are testing and carrying the amount of exercise further and further until the limitations seem almost out of sight. Of course a great deal depends upon the desire of the patient. During the war a great many of these men, if they made their test, were sent back to the front, and they did not always like that. I remember one lady who asked a man who was in his bed, "My man, I suppose you are eager to get back to the front?" and he said, "Yes, I am; I do not think." Now in the case of the school child and the college student we have two classes, that class of men who do not wish to take the amount of exercise they should, but the considerable class of men who wish to

take more than they should, and most of us who spend our time in taking care of the physical health of large bodies of students find that our time is spent equally between these two. I have been surprised at the extent to which we can allow competitive exercise to men who have heart lesions. Some time before the war a man in Strassburg suggested that an exhaustive study be made of heart murmurs in cases supposedly normal and took 1000 cases of supposedly normal students and found heart murmurs developed in about 70 per cent. It became the rule rather than the exception. The general practitioner is frequently misled in exaggerating these maladies by any abnormal sound or slight irregularities of the heart. As a matter of fact, the "proof of the pudding is the eating." The proof of the heart doing work is doing it. The test is the actual work put upon the heart itself. The great thing brought up by Dr. Brush especially is the fact that they have lifted the curse of fear from these children and these adults. There is nothing so pernicious as making a patient of that kind feel that he is an invalid and must go carefully or he will drop dead. Continually we get letters from physicians that so and so must not take any exercise because he has a weak heart, and in nearly all these cases we have a young man who should take exercise in order to bring about the very condition that has been described and shown tonight. I would say a word about the question of exercise. That has been elaborately investigated, and while it is not necessary to go into statistics, it has been shown that even when they have this kind of competitive exercise in the normal heart it does not reduce expectation of life. In competitive rowing, both in America and in England, where some 400 to 500 men have been followed in their entire life, because rowing has been practised fifty years or more, in these cases the expectation of life has been slightly greater than the expectation of life of the insurance companies, and in no case has the frequency of heart disease been increased. The same applies to a long-distance runner, and even to Marathon runners, which is the heaviest test we can get. The condition of exercise of the heart has been more or less practised for a long time by Stokes, of Dublin, and the Schott brothers, in Germany. I think in no place that I know has this been worked out so intelligently and in such a practical way as in the way that we have found tonight. I believe there can be no danger in a young patient of overstraining if the precautions prescribed are observed. That is, if they show any definite symptoms of breaking down they are taken out at once. I do not believe that any exercise they will voluntarily take will injure or aggravate the heart condition.

Dr. George W. Norris: The papers that have been read this evening are not only instructive, but they ought to act as a marked stimulus

to us here in Philadelphia, a stimulus not only to the medical profession, which already has gone into this work in various hospitals, but should also stimulate an interest upon the part of the public at large. It is the public at large we must have back of us in this undertaking in order to supply many of the facilities that are absolutely requisite. Something has been said tonight in reference to prevention. It seems to me that a good deal can be accomplished in the way of prevention by societies of this kind. It is not many years ago since citizens of the great state of Pennsylvania knew nothing, and cared less, about tuberculosis, and about that time, ten to fifteen years ago, a society was organized, a Pennsylvania society for the prevention of tuberculosis. To my mind the main thing that society accomplished was that they acquainted the public in regard to this disease and got the public interested. It is impossible to go even into the by-ways of this state today without finding that the average citizen has some comprehension of how tuberculosis is spread and in a general way the measures that interfere with its development or hinder it. It seems to me that it is not at all unlikely or inconceivable that the same sort of knowledge can be spread in the same sort of way. If we can succeed in bringing to the attention of the public at large the great causative factors of heart disease, if we can teach that the child with rheumatic fever and chorea requires care for a long time, I think a great deal has been accomplished.

Dr. James M. Anders: I was very much interested in the papers of the evening, and I could not help but feel that the advances made during the last quarter of a century along the line of sanitation and bacteriology have been so notable as to make preventive medicine a real specialty. We have known for many years the scientific basis on which control and even prevention of heart disease rested, but yet only recently has organized effort been made, as we have heard tonight, in New York, which was enabled to meet the economic and social aspects of the question, which are so important and so far-reaching. I will not go into detail, but I for one hold that the paper of Dr. Conner will serve as a sort of Gideon's trumpet, the sound of which will cause not only Philadelphia, Boston and Cleveland, where beginnings have already been made, to follow the excellent example in New York, but all other large communities throughout the country. One thing is certain: while most attention has been given this evening to the question of relief of heart conditions a good deal has been said about prevention. I agree with Dr. McCrae that so far as prevention is concerned the problem rests largely with the medical profession itself, and yet even here organization is important, as shown by the end chart which was shown by Dr. Conner, where the

numerous contacts between the cardiac clinic and various agencies brought about by the social service nurse. I think we must have in the work of prevention perfect organization and the assistance of good social service workers. No organization, however, can be considered complete, can meet all the indications of the situation, without the convalescent home feature which Dr. Brush has so interestingly presented. I feel that here in Philadelphia and elsewhere that this element of the question must be carefully considered and adopted in connection with the cardiac clinics which have already been started.

PRESENTATION OF A LETTER FROM JOHN HUNTER TO EDWARD JENNER.

THE PRESIDENT: I will ask Dr. Lewis to present a communication to the College.

DR. MORRIS J. LEWIS: I have a very interesting letter which I wish to present to the College. Sir James Paget presented it to Dr. S. Weir Mitchell and it passed to his son, Dr. John K. Mitchell, and Mrs. Mitchell gave it to me. I present it to the College, with her knowledge and approval. It was written by John Hunter to Edward Jenner in 1791.

DR. FRANCIS R. PACKARD: I move that a vote of thanks be extended to Dr. Morris J. Lewis and also thanks to Mrs. Mitchell for the very wonderful letter, a valuable one for the collection of the College of Physicians.

Dear Jenner

I was in hopes of having seen you in London long before now, but I have been informed that Mrs Jenner has been extremely ill when you come I hope you will bring her with you; we will take all the care we can of her. Now that the Hedge Hogs are gone to sleep. I could wish you would get some of them for me, and put them in a Box with very loos and course straw so that they might have air and not tumble about on each other, I want to open a few. when you catch them do not put them into a warm place to make them lively, the more stupid the better they will carrie and live. Ever yours

Decr 10th 1791 John Hunter

HUNTER TO JENNER

The Gift of Sir James Paget, Bart.

Dear Jenner

I was in hopes of having seen you in London long before now, but I have been informed that Mrs. Jenner has been extremely ill. When you come I hope you will bring her with you; we will take all the care we can of her. Now that the Hedge Hogs are gone to sleep, I could wish you would get some of them for me, and put them in a Box with very loos and course straw so that they might have air and not tumble about on each other, I want to open a few. When you catch them do not put them into a warm place to make them lively, the more stupid the better they will carrie and live. Ever yours,

Dec. 10th 1791 John Hunter.

PRESENTATION OF A POCKET-CASE BELONGING TO CRAWFORD W. LONG.

Dr. Francis R. Packard: I have here a pocket-case which belonged to Dr. Crawford W. Long, which is presented to the College of Physicians by his daughter, Mrs. Frances Long Taylor, of Athens, Georgia. Many persons have sworn to the fact that Dr. Long used ether a number of times between 1842 and the time that W. T. G. Morton first publicly demonstrated the advantages of ether as a surgical anesthetic in the Massachusetts General Hospital in 1846. This case was used by Dr. Long in his practice, and was a part of his equipment, which he carried with him for many years. His daughter, Mrs. Frances Long Taylor, acted as his secretary. I should like a vote of thanks to be extended to her for her kindness in giving it to the College.

SPECIAL MEETING IN HONOR OF MADAME CURIE.[1]

ADDRESS OF ROBERT ABBE, M.D.

NEW YORK

You will find an illustrated booklet in each seat of this hall describing the mementos of the five great names of our profession and of science, which are the milestones of scientific progress in the healing art during the past century or more. These mementos are tonight exhibited for the first time in a case in which they will permanently remain in your keeping.

Your reading of this booklet now or at your leisure will save the time necessary for the telling and enable me to occupy the few moments before Mme. Curie's coming tonight to explain more fully the object of her presence here and of her visit to our country.

Those of us who arranged her itinerary in this short six weeks between her leaving Paris and returning to it have faced an enormous demand for her presence at universities, societies and cities all over our country. Knowing her delicate health, and the need of conserving her strength, we have chosen such visits and duties as would satisfy her wishes and the universal desire of institutions of learning to see her, and yield the greatest benefit to science and popular education without fatiguing her, and yet stimulate her life, if possible, to complete the wonderful work ahead of her.

She comes to us after many years of fatiguing labor. The great war took toll of the University of Paris from the first gun fire. Most of the students and the great corps of professors and

[1] Read May 23, 1921.

teachers abandoned the class-room for the battlefield. She was among the first to abandon her laboratory, and until the day of the Armistice was at the front with her daughter in x-ray work.

When she returned all was desolate. It was as if life were either to stop or to begin over again.

By almost an act of genius the initiative of an American, Mrs. William B. Meloney, accidentally a visitor to Paris on another mission, touched a key that evoked an appealing note of sympathy in the hearts of the women of our country. An extraordinarily spontaneous response called out working committees of women all over our land. By admirable organization one of the largest purely woman's movements has excited a sympathetic feeling for the triumph of pure science—as illustrated in Mme. Curie—and also by innumerable small contributions from women created a fund to present her with the accessories for equipping her disorganized laboratory.

She has confided the fact that one of her desires has been to come here tonight and personally present and dedicate the historic scientific instrument which you see before you to such educative purpose as its presence may evoke.

When I finally brought it safely to my office a few days ago—after many vicissitudes—and unpacked it tenderly, my assistant was touched by its impressive meaning and said, "Don't you think it will be lonely over here?"

I said, "Yes, perhaps, until Mme. Curie comes and places her hand affectionately on it and commends it to our care."

That, my friends, she will do in a few moments.

Her reception in this country will be a just tribute to one of the world's most distinguished woman scientists; but nothing, I judge, can equal the momentous and thrilling ovation given to her a fortnight ago in Paris on the eve of her departure.

The scene was the great Opera House.

The stage was set by Guitry, the Belasco of the French Theater. The house was packed with a distinguished audience.

Flags, decorations and music were elaborate. The curtain rose on a stage filled with officers of state, professors of the univer-

sity—in robes—and in the center the modest, shrinking, woman savant. Splendid addresses were given, laudatory and impressively true.

Then the curtain fell, only to rise again on a stage cleared of everything but a small table behind which Sara Bernhardt, the greatest living tragedienne, rose to deliver a brilliant eulogy written by the master of French dramatic writing, Rostand. The effect was thrilling, but thunders of applause and calls for Mme. Curie failed to bring her from behind the scenes where she had been bashfully listening to Mme. Bernhardt. I have been told by a lady who witnessed the scene that there was no climax, but a succession of tributes, one after the other, followed by an elaborate "movie" of Mme. Curie's life especially prepared by actors on the scene of her early home and laboratory work with her father, professor in the University of Warsaw, where she was his devoted assistant until she came to Paris at twenty years of age.

The scenes then depicted French university work in laboratory and mine, with detailed views of the veritable workshop and scenes of her triumph in the epoch-making discovery of radium.

From such an emotional farewell she made her first crossing of the ocean, and, yesterday, was the center of interest at the most momentous scientific event ever given at the White House, when President Harding presented to her the gift from the women of our country, a gram of radium. The President made one of the most beautiful addresses I have ever heard, full of charm and dignity. Mme. Curie responded most happily. Before her was the fine mahogany box containing the precious mineral which she had discovered, confined in an interior case of lead weighing a hundred pounds. The little gold key to this box was presented to her by the President, which she afterward wore around her neck on a tri-color ribbon.

From the fatigue of that and other ceremonies she comes to us tonight with particular pleasure to dedicate the memento which will repose in your cabinet. You will see in her a woman of rare charm, but the antithesis of all that savors of pompous-

ness. She has the tenderest heart in her frail body, but the keenest sense for all scientific conversation, with unaffected disdain of small talk.

I desire to say a few words regarding the care of mementos you see on the platform and the custodianship of them, worthy, I hope, of your perpetuation.

More than ten years ago, as you know, there was presented to me the beautiful gold watch of Dr. Benjamin Rush, one of your society's founders and a hero of Revolutionary days. It was made the subject of a custodianship to be held as an honor, by successive members of our profession who represented the same high qualities of mind and lifework as he did. The first custodian was Dr. Weir Mitchell. He chose Dr. Simon Flexner as his ideal and successor. Dr. Flexner, after three years, passed it on to Dr. William H. Welch, who accepted the honor and is its present custodian, to the delight of everyone, saying: "Why! It's like the gold-headed cane."

I saw the gold-headed cane in the College of Physicians' cabinet in London last summer, and with it were five other treasures: First, a pair of scissors belonging to Jenner and a cow's horn from one of the historic animals used in vaccination; second, a small wooden stethoscope used by Laennec; third, a short ebony pointer used by Harvey in his lectures on the blood; fourth, a small silver platter given in 1661 by the Fellows of the College, but stolen in 1666 at the looting during the great fire of London. It was lost for 250 years and was recovered at a collector's sale of old silver a few years ago.

I was inspired by this small group and by its effect upon me —to think I might acquire some things worthy to add to our custodianship. My hope was of Lister, Pasteur and Curie, but from the first inquiry I was given discouragement.

Pushing my endeavors during my short stay in London and Paris, I was at last rewarded by three remarkable gifts of veritable treasures, of each great name, and these I present tonight:

A box of surgical instruments used by Lord Lister.

A large model of a tartrate crystal used by Pasteur.

A wonderful historic instrument made by Pierre Curie, and used by him and Mme. Curie in her immortal discovery of radium.

These memorable souvenirs probably cannot be duplicated anywhere outside of the Lister, Pasteur and Curie Museums. They were secured through the assistance of Dr. Keen and Dr. Gibson, and by the gifts of Sir Rickman J. Goolee (Mr. Lister's nephew), of Calmette and Roux (Pasteur's assistants and successors), and of Mme. Curie herself.

In the possession of this institution there has been an inkstand of Jenner, which was given by Dr. Weir Mitchell, and has been permitted to repose in this cabinet as one of the memorable souvenirs.

With these five in the cabinet are portraits of each distinguished scientist and a beautifully bound volume of historic data, biographic notes and autograph letters of each.

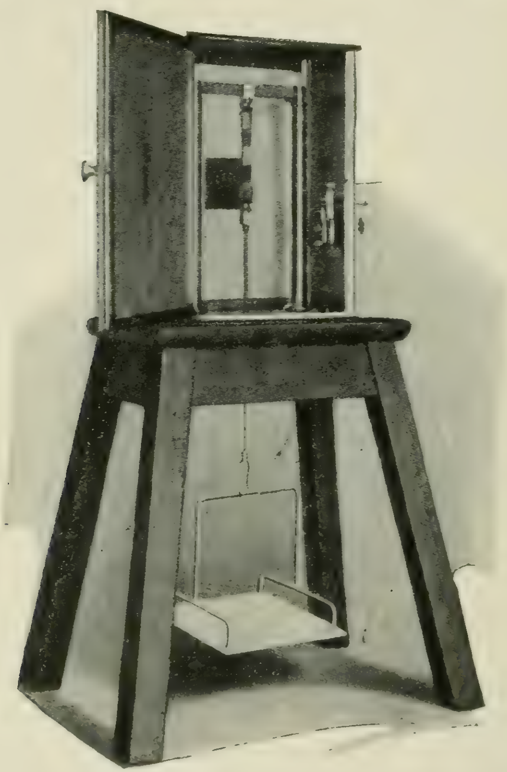
In addition there are the custodianship conditions and portraits of each successive custodian, with his letter of nomination and acceptance.

These, in the coming years, will constitute a memorable collection of our own illustrious scientific, educational and humanitarian fellow-men whose deeds and lives will be worth emulation.

When, in a few minutes, Mme. Curie arrives and President Taylor invites her to formally present her great gift, to place her hand upon it, affectionately bid it good-bye and commend it to its good purpose as a permanent part of this cabinet, we will realize that for all time it will bear the actual finger-prints of the discoverer of radium, as the Pasteur crystal model, the Lister instruments, the Jenner inkstand and the Rush watch do of their former owners.

If I were asked again, "Will it not feel homesick?" I would say: "Let us imagine some future evening here in this beautiful hall after the scientific audience has gone, the lights are turned out, the janitor has made his rounds, locked the door and gone home, the moonlight streaming in the tall windows near the case, and the Liberty Bell in Independence Hall has struck midnight by some fairy hand. Then the little fairy spirits that stand

guard over these mementos awake. From the Curie instrument one stretches out his hand and touches another of one guarding the Pasteur crystal, grasps it and a chatter in French breaks the silence. This wakes up the sprightly guardian of Lister's instruments and Jenner's inkstand, who join in an international



parley at which the American spirit of Dr. Rush climbs out of his invisible retreat and they all dance about and narrate their wonderful past.

"Then one can see as the dawn breaks they all hide again invisible. The janitor unlocks the library and visitors come to study and pay homage to the great names we all worship.

"This historic instrument will not be lonely."

Of all the galaxy of stars illuminating the past, none commands greater reverence than Pasteur. The portrait of him most treasured by the Institute has been perpetuated in a fine large etching presented to us by Calmette and brought over by Dr. Keen. It is in beautiful contrast as showing the fine serenity of his later life to the earliest known portrait of which I find a copy in Dr. Weir Mitchell's collection in your library. This early one is so rare that few know of it. That early face is the pure scientist, typified in a quotation which is a tribute to his character, taken from one of his letters to his young love in offering his life to her. He says:

"Time will show you that below my cold, shy and unpleasing exterior there is a heart full of affection for you."

Mme. Curie seated (1921) before the original Quartz-Piezo Electrometer, made by Prof. Pierre Curie.

Perhaps the main influence of this memorial case will be a tendency to raise the tone of the life of our future professional men by spreading before us some of the attributes of the highest lives devoted to the healing art, whose hearts have been completely devoted to this fruitful work.

There exists today, as always, a commercial tendency which

needs to be neutralized. It is the same in business. One reads on the advertisement boards of a business college this legend, "We turn time and brains into money." What sacrilege! Time, given in our short lives for some worthier purpose—"Time is Mine, I will repay," saith the Lord. And brains, to search out the Creator, if happily we may find him.

Is there no greater aim than making money? Let those who have so given their lives turn their accumulated wealth into the treasures of our laboratories and universities, and, after all, find the joy of service. Already fortunes are being diverted to science.

It has been a heartwarming sight to see the universal response of the women of our broad land, poor and rich, contributing as they could to the fund to equip Mme. Curie's laboratory. The great good that has emanated from them is sure to be now continued.

At the close of Dr. Abbe's address, Madame Curie arose and placing her hand on the apparatus said, "I am glad to present this instrument to so distinguished a society."

Radium as a Therapeutic Agent

By JOHN G. CLARK, M.D.[1]

Soon after the discovery of radium by Mme. Curie the scientific world was set face to face with the revolutionary fact that a force of incredible potentialities was uninterruptedly being released from this substance, and yet almost innumerable centuries would pass before even a microscopic speck would finally become inert. Such an inthrust into the apparently well-established

[1] Read May 23, 1921.

laws of physics at once stimulated new investigations, out of which has come the staggering possibility of atomic dynamics, and it is even now predicted that we may be upon the threshold of a new era in physics dominated by these resistless forces.

At first physicians viewed this new substance as an astounding discovery without any thought of its relationship to medicine. Then came the query of the restless seekers of our guild, ever on the alert for new remedies, May not radium be of curative value? As malignant growths had shown in certain instances a favorable reaction to the *x*-ray, it was thought possible that from this much more powerful agent a still more happy outcome might be anticipated. These first investigations soon revealed the fact that the vitality of malignant cells, such as constitute cancer and sarcoma, responded very differently to irradiation from those of normal tissues, the vitality of malignant cells being much more easily destroyed, with resultant degeneration. The proper graduation of the irradiation then became the paramount issue, for a slight overdose is also most destructive to healthy tissues. For instance, in one Austrian clinic several hopelessly stricken cancer victims were subjected to this force with quickly fatal results because of its prolonged and unguarded application. The healthy as well as the malignant tissues were irretrievably destroyed. By a more judicious application, however, with careful screening out of the injurious rays of radium and with the protection of the healthy parts, it was found that the cancer cells could be killed, and yet with such slight injury to the surrounding tissues as to leave them capable of efficient repair and regeneration.

These observations opened up a new avenue of hope in a disease that has been so recalcitrant to any treatment less than radical excision, and investigators resumed with new energy the study of malignant growths. A few decades ago cancer was looked upon by our profession as a blood disease, and such eminent figures in surgery as Gross and Agnew, of this city, felt that when they removed a given area invaded by a malignant process that they were only stamping out a local manifestation which must inevi-

tably break forth with renewed violence in some other part of the body. Under such a depressing assumption they sought through an operation only to make life a little less free from some of the agonizing phases of this disease. As a medical student I heard the great Agnew assert in the last year of his long life as a surgeon that he could not say that he had ever cured a case of cancer of the breast by an operation. A very gloomy forecast, indeed, for the cancer victim, and a profoundly pessimistic attitude of our profession was the inevitable outcome of such a doctrine. So long as surgeons were under the sway of this misleading theory, operations were only performed when the case had reached a hopeless stage. Of the succeeding school of surgeons there were a few who like all makers of great historic events broke away from this traditional theory and attacked cancer at its very earliest appearance by a much more extensive operation than had hitherto been employed, and within a decade they brilliantly demonstrated beyond cavil that cancer at first is a local and not a blood disease, and if stamped out thoroughly will not recur. Soon a very encouraging series of cures of cases of cancer of organs and various parts of the body began to appear in medical literature.

For instance, in cancer of the breast, concerning which Agnew spoke so hopelessly, a large percentage of cures in operable cases was recorded, and coincident with these reports the old theory of a blood disease, which had been held for a century or more, was finally and for all time thrown into the discard. Surgery, therefore, offered the first real hope for the individual stricken with cancer, but obviously this boon is only for the one who is fortunate enough to have the growth appear in a part accessible to the surgeon and who seeks surgical aid upon its earliest manifestation. This surgical renaissance, however, is still retarded through an age-long skepticism in which the medical profession all too frequently participates because patients, in the painless stage of the disease, which is always the operable stage, will not submit to an early operation, and usually come too late for

any possibility of a cure, hence the surgeon has made slow progress. Happily the lay world now more fully realizes through many demonstrated cures that in surgery there is hope, and among the intelligent classes we now have full coöperation between the patient and the surgeon, and the last decade, therefore, has furnished much more encouraging statistics. But even under this more favorable outlook the number of curable are far less than the hopeless cases. Surgery has reached its fullest limit and can go no further in the way of new operations. Some other supplementary remedy, therefore, must be found if a further advance is to be made into this great domain of incurability. New remedies are constantly appearing, such as sera, chemical injections, etc., but not one has proved of lasting value. In radium, however, we have encouraging possibilities. Already cases which could not be touched by a surgeon have been cured. Even when an operation is to be performed it offers a much greater assurance in many cases after the surgical work is completed of rendering more effective the further treatment of the case. A distinct and very valuable therapeutic epoch has therefore been marked by the radium treatment of various tumors. At this time an extended statistical discussion is out of place, for we are here to do honor to Mme. Curie.

Briefly, however, in cases of cancer of the face, the eyelids, the tongue and various other skin localities, where an operation is so mutilating as to well-nigh ban it from approval, radium has taken its place with the most gratifying results. Instead of the great disfigurement caused by an operation the disease has frequently been stamped out with only a slight scar marking the site of healing. Also after operations, when there has been a local recurrence, after the major part of the growth has been surgically removed, radium has acted most beneficently in retarding the growth or actually in effecting a final cure. In cancer of the uterus, perfectly hopeless cases in which there was not a possibility of even a palliative operation, cures have been noted; in others the patients have been given a much longer and happier

lease of life even when the final end was inevitable. To this list of malignant cases may be added a very large number of benign tumors, especially of the fibroid class, which yield almost magic results in properly selected cases to the effects of this remedy. During the last year in the gynecologic clinic at the University Hospital of 205 women suffering with fibroid tumors of the uterus 100 have been saved from a major abdominal operation by the use of radium.

So one might record indefinitely the great therapeutic range which radium is now covering, and thus far we are still in the early stage of investigation. Because it is a dangerous remedy if illy used, and a most beneficent one if properly guarded, the surgeon should invariably be the final judge as to whether an operation or irradiation is applicable to a given case, for this remedy does not supplant surgery but stands as its splendid adjuvant.

It has been said that the great discoveries of the world are often marked by intervals of centuries. One hundred years ago there was born in Alsace, Louis Pasteur, who by his epoch-making discoveries revolutionized medicine. He established the germ theory of disease, which has been of transcendent value, and now dominates every phase of infectious diseases. The surgery of today with all of its triumphs could not have been initiated without the basic work of Pasteur, for Lister, the founder of modern surgery, initiated all of his investigations after the former's discoveries. Pasteur was so devoted to France that during the Franco-Prussian War he was almost crushed with grievous apprehensions as to the outcome and felt that he could go no further with his work, as his anxiety was so great for the fate of his country. Fortunately for the world he maintained his divine stimulus to push forward, and the results of his investigations when embodied in the healing and surgical sciences yielded results which saved France from destruction during the last five years. Had it not been possible to prevent the many germ-generated diseases and quickly restore the dangerously injured soldiers by aseptic and

antiseptic surgery to full efficiency which returned them to the battle lines, France could never have maintained in the field a force sufficient to hold back the overwhelming Teutonic army. The immortal soul which grieved for his poor stricken France little realized in his great modesty that he was giving life to a new force which would save his beloved fatherland when she was again laid under the scourge. We can never honor Pasteur sufficiently, nor can we measure the incalculable good which he has conferred upon humanity.

Tonight we stand in the presence of this very great French woman, who also has made a discovery in the field of chemistry and physics which, too, has boundless curative possibilities. We know that in radium, medicine has found a remedy which has opened up the greatest hope of healing possibilities. This aspect of Mme. Curie's discovery, however, may have a range of infinitesimal scope as compared with what may come when the titanic energy of the atom is released from other substances as it is from radium.

Whatever the final outcome may be we know that our guest of this evening is one of the greatest discoverers of all ages. While next year the medical profession of all countries will impartially celebrate the one hundredth anniversary of the birth of the great Pasteur, a world benefactor, and will deposit upon his tomb its wreaths of immortelles, tonight we have the great felicity of presenting the laurel wreath to Mme. Curie who honors us with her presence. Among all the achievements of the French none will find such imperishable places in science as those great epochs marked by Louis Pasteur and Mme. Curie. As a representative of the medical profession of Philadelphia, and in behalf of the large number of patients in this city and state who have had their lives prolonged or have been made well by radium, I extend to you, Mme. Curie, our boundless thanks.

The Physical Properties of Radium[1]

By ARTHUR W. GOODSPEED, Ph.D.

As your President has said, the duty has been imposed on me to say, briefly, something of the physical properties of radium—what it is and what it does. It is the element which was discovered by our guest of this evening more than twenty years ago. It occurs in all the ores which contain the well-known element uranium. The subject is so broad, and contains so much of well-known and unknown science, that I will occupy only a few moments in showing you two or three demonstrations of radium and the material which comes from radium just as it itself comes from the parent substance which produces it. Radium seems to be the key to inorganic evolution. Just as everything organic changes with comparative rapidity, so it has been shown by a study of radium and some other inorganic substances that they too are constantly undergoing a change and that the radium which we have all read about, and which we are always learning more about, was originally a part of the inorganic element uranium. In the changes of uranium down through various substances we have three or four steps before arriving at radium. Uranium is, as you know, the most massive of any element we have, and perhaps for this reason it is more likely to change spontaneously. Radium is known to disintegrate into a definite number of substances, and this is accompanied by the ejection of several kinds of so-called rays known as alpha, beta and gamma rays.

The alpha rays are material particles, atomic in size, carrying a positive electric charge. After losing this charge these particles are helium atoms.

The beta rays are particles subatomic in size and are atoms of negative electricity, *i. e.*, electrons.

The gamma rays are like light rays of exceedingly short wavelength. They are similar to very short *x*-rays.

[1] Read May 23, 1921.

The radioactive process is an atomic explosion, the particles being emitted with great speed, from $\frac{1}{10}$ to $\frac{9}{10}$ that of light. This implies a vast storehouse of intra-atomic energy. A gamma ray starts as an ether pulse at the instant an electron is emitted, just as an x-ray starts when an electron is suddenly stopped. Starting and stopping is just the same kind of an act, one being the negative of the other.

I have here a small piece of uranium ore known as carnotite, which is the chief source of radium in this country. As it contains, however, only about 2 per cent of uranium, the radium content is only about 5 mg. per ton of the ore. It is readily seen, then, why radium is so expensive to obtain; there is very little of it, and the labor necessary to get it is very great. The material that Mme. Curie worked with in her early experiments in 1898 was the residues of some of the Austrian uranium mines after the uranium had been extracted from the ore. Becquerel had discovered in 1896 the remarkable property of uranium known as radioactivity, and this suggested to the Curies the probable existence of other substances in uranium ore. Thus, Mme. Curie with her husband came to find radium a far more active substance than uranium. At once other chemists in Europe separated small quantities of radium, and I have the privilege of showing you tonight, and perhaps Mme. Curie, too, will be interested, the first samples of radium to be seen in this country. This was in 1899. My predecessor at the University of Pennsylvania, Prof. G. F. Barker, was in Europe at the time and secured these from the de Haën laboratory in Hannover. The percentage of radium content in these samples is obviously very small; but note that the material cost but \$2 per gram while the single gram recently acquired by Mme. Curie cost the women of America about \$100,000.

Notice the blue color of the bottles which has been produced by the rays. Also a very faint luminosity can be detected in the dark. This is interesting, as many substances acquire this property while radium rays impinge upon them. One of my associates at the University, Dr. Kabakjian, after at least two years of effort, has worked out a very efficient method for

extracting radium from low-grade carnotite, and his process is being used at the Radium Chemical Works at Lansdowne, near this city, and I am indebted to Mr. W. L. Cummings, the proprietor of that plant, for the loan of several thousand dollars' worth of radium for experiment here. This morning Dr. Kabakjian very kindly prepared for me this cylindrical glass tube thinly coated within with zinc sulphide.

The first disintegration product from radium is a gas which is itself many fold more active than radium. An atom of this gas is formed by the expulsion of an alpha particle from an atom of radium, and the gas is called radium emanation, or niton. It is thought that these atomic reductions go on until finally a lead atom results. If there is further change it is so slow as to escape detection.

Within the tube referred to, and which I hold in my hand, a very minute quantity of the gas niton has been placed. Within this Dewar flask there is liquefied air, which is exceedingly cold, having a temperature of—190° C. If I dip the tube part way in the liquid air the niton within will be precipitated as a solid upon the zinc sulphide, because of the cold, and the salt will at once become quite luminous over the surface immersed, due to the impacts of the ejected alpha and beta particles and the gamma rays. This process will quickly proceed until most of the niton is condensed and the lower part of the tube is very bright. These particles are emitted with the tremendous speed of 20,000 miles per second and more. We may thus picture to ourselves a possible mechanism through which radium produces a therapeutic effect either for good or ill. These particles are very, very fast-moving bullets, which may destroy organisms when they hit.

But I must hasten to another experiment which Dr. Kabakjian has prepared for us, and which illustrates a result from his own researches in radioactivity. He has named the phenomenon thermo-radio luminescence. Here is a tube which contains 25 mg. of radium bromide of rather high grade. It was heated some hours ago, and under the bombardment of its own rays it is perhaps the brightest specimen of radium any of you have ever

seen. The energy transformations in this experiment seem to be in a reverse order from those in the well-known phenomenon of thermo-luminescence, in which the specimen is first subjected to the action of rays and then heated.

Since radioactive substances are constantly ejecting particles and radiation the inference is that the energy used is within the atom, and thus we have discovered a vast storehouse of intra-atomic energy, which in the case of each atom can be calculated though it cannot now be controlled. For example, if it were possible to extract and use at will the total intra-atomic energy of the gram of radium Mme. Curie has just received, it would be sufficient to transport her with her two daughters in a light automobile from here to her birthplace in Warsaw, if we only had a good bridge over the Atlantic.

The application of radium to surgery I am not competent to discuss, but one reference to its alleged use in medicine I should like to mention: Some weeks ago I received some literature describing some radium bromide pills and their uses. They were prepared in two potencies, denoted 12x and 30x. I purchased a bottle of the pills and the makers very kindly explained the meaning of the terms used. A small mass of high-grade radium bromide is mixed with nine times as much milk-sugar, and this 10 per cent mixture is of strength 1x; one part of this is triturated with nine parts of milk-sugar, making a 1 per cent mixture, and called 2x potency. Thus to obtain a product of 30x potency this process must be repeated thirty times, the final proportion of radium bromide being 10^{-30} or: $\frac{1}{1{,}000{,}000{,}000{,}000{,}000{,}000{,}000{,}000{,}000{,}000}$ or according to American notation a nonillionth. Now modern science teaches us how to calculate the number of molecules in 1 gm. of any particular substance, and since each of these pills has a mass of something less than one-tenth of a gram, it is a matter of simple computation to show that in order to get a single molecule of radium bromide one must take a dose of these pills large enough to fill over 4000 barrels holding 300 pounds each. I may add that it is stated in the directions on the containers that "two or three tablets dissolved in a glass of water" constitutes

the dose. Or we may look at this in another way: Suppose a patient withstands the ravages of one of the many diseases alleged to be cured by these pills until he arrives at an age when powerful drugs may be safely given and then becomes afflicted. Radium bromide 30x is prescribed in doses of two or three pills twice a day. In this treatment, if it be continuous, the patient will receive on the average only one molecule of the medicine per about 1,000,000 years of his life.

THE OCULOCARDIAC REFLEX AND ITS THERAPEUTIC VALUE[1]

By ALFRED GORDON, M.D.

The reflex, to which attention was called first in 1908 by Ashner,[2] presents a great variability in normal and pathologic states. It consists in the majority of normal cases of a retardation or slowing up of the pulse within five to twelve beats per minute, produced by compression of the eyeballs during one-quarter or one-half minute. In addition to the cardiac phenomenon the following symptoms are not infrequently observed: Headache, vertigo, noises in the head, and sensation of heat or cold. The predominant symptom is the bradycardia, which is almost constantly in direct relationship to the degree of the ocular compression. The best procedure of obtaining the reflex is to place the individual in a lying position, the head well rested and the eyes closed. With the pulp of the index, compression of the eyeballs is produced by pushing the eyeballs into the orbits. Among the phenomena mentioned above, the cardiac manifestations are the most conspicuous. When only the right eye is compressed the cardiac rhythm is more modified than when the compression is done over the left eye, that is, pressure over the left eye produced a less marked bradycardia than with the opposite eye. Binocular compression gives about the same results as right monocular compression. The average diminution of pulsations in normal individuals is from five to twelve. Curiously enough, in very exceptional cases instead of bradycardia acceleration of the cardiac rhythm is observed.

[1] Read June 1, 1921.
[2] Wien. klin. Wchnschr., p. 1520.

As to the reflex pathway, in all probability it follows from the eye through the branches of the fifth nerve to the medulla, from which center it reaches the moderators or accelerators of the heart, and according to which of the latter is stimulated, bradycardia or tachycardia will be the result. Such a pathogenesis could readily explain all other phenomena concurrent with the disorder in the cardiac rhythm.

The investigation of the oculocardiac reflex was conducted in a large number of the following pathologic conditions: Hemiplegia, epilepsy, paralysis agitans, Graves's disease, multiple sclerosis, tabes and paresis.

In cases of epilepsy (27) the writer found intensification of the reflex; instead of 5 to 12 pulsations per minute there was a diminution of 12 to 30 beats, more pronounced in females than in males. While the range of rhythm variation is large (12 to 30), nevertheless it was always constant in the same individual during repeated examinations.

Most interesting data were obtained in tabes. Nineteen cases of tabes were repeatedly examined for the oculocardiac reflex. The latter was found absent in 13 and decidedly diminished in 6 cases. The decrease of the number of pulsations was 3 and 4. In the cases with abolition of this reflex the Argyll-Robertson pupil was present. In 3 cases with diminution of radial pulsations the Argyll-Robertson phenomenon was absent, but the oculocardiac reflex eventually disappeared and then the Argyll-Robertson pupil made its appearance. These facts are highly important from a diagnostic standpoint, as it adds a valuable sign to the group of signs well known, and it may lead to the proper recognition of the disease in its early phases when the pupillary reflexes are still normal. Moreover, the abolition of the oculocardiac reflex is an indication of an ascending course of the tabetic process showing an involvement of the bulbar sensory roots.

In 5 cases of paresis the oculocardiac reflex was pronounced. Compression of the eye-globes produced a diminution of the number of pulsations from 30 to 42. This is an indication of

disturbance along the pathway of the arc reflex from the trigeminus to the medulla, or from the medulla along the pneumogastric or sympathetic nerve, or else in the medulla itself. Bulbar symptoms are not infrequent in paresis, such as disturbances of secretory function, vasomotor, respiratory and circulatory disorders and difficulty of deglutition.

Oculocardiac Reflex. Figures Indicating Diminution of Number of Pulsations.

Epilepsy, 27 cases.		Tabes, 19 cases.		Paresis, 5 cases.		Paralysis agitans, 10 cases.		Graves's disease, 7 cases.	
5 cases	12	13 cases	Absent	2 cases	30	6 cases	Absent	3 cases	15
12 "	18	3 "	3	1 "	38	1 "	5	1 "	25
8 "	20	3 "	3	1 "	35	1 "	8	1 "	38
2 "	30	....		1 "	40	1 "	2	1 "	5
						1 "	3	1 "	Absent

Disseminated sclerosis, 3 cases.		Hemiplegia, 12 cases.	
2 cases	Absent	10 cases	Absent
1 "	5	2 "	10

Ten cases of paralysis agitans were examined for the oculocardiac reflex. In 8 of them the Parkinsonian picture was bilateral. In 2 of the 8 cases there was no tremor, but the other symptoms were all present, namely, mask-like face, stiffness of the trunk, general attitude, small steps in walking, finally the propulsion phenomenon. The oculocardiac reflex investigated in each of these subgroups was found totally absent in 6 of the bilateral cases in which the characteristic tremor was present. It was normal in the two bilateral cases without tremor. It was diminished (2 and 3 pulsations respectively) in the 2 unilateral cases, more feeble when ocular compression was carried out on the affected side than on the opposite side. If one considers the anatomopathologic data of paralysis agitans one finds a diversity of disorders, but their elective localization is bulbopontine. The trigeminal nerve, the afferent part of the reflex arc under discussion, enters the pons on the external side of its inferior surface where the middle cerebellar peduncle joins it. Disturbance

of equilibration, static and dynamic, is present in paralysis agitans; the tremor itself is one of its manifestations. A lesion, therefore, in the pons in the vicinity of the nucleus of the fifth nerve (which is the center of the oculocardiac reflex), leaving intact the sensorimotor but affecting the cerebellobullar pathways, will readily explain all the symptoms of Parkinson's disease as well as the abolition or diminution of the oculocardiac reflex.

A very interesting condition was found in the unilateral cases. In testing them for the oculocardiac reflex it was observed that not only the latter was more altered on the affected side than on the other, but also the ocular compression increased the tremor on the corresponding side. It seems therefore that the oculocardiac center in the mesencephalon is in close vicinity with a center, a lesion of which is liable to produce tremor.

Seven cases of exophthalmic goiter were examined. Five presented a marked accentuation of the oculocardiac reflex; the number of pulsations decreased 15 to 38. One case without exophthalmos presented only a slight diminution of the pulsations (5); in the remaining case the reflex was absent. Here the manifestations of Graves's disease were exceedingly slight. The interpretation of the alterations in the number of cardiac pulsations can be here explained on the basis of different states of the pneumogastric and the sympathetic nerves. Ordinarily in Graves's disease there is a hyperexcitability of both nerves (as proved by the administration of pilocarpin and adrenalin).

According to the researches of Eppinger and Hess some cases react to substances that are liable to modify the function of the vagus, such as pilocarpin, producing the following symptoms: Salivation, perspiration, flushes of heat and peristaltic movements of the gastrointestinal tract. In other cases of Graves's disease the above reaction is absent, but under the influence of adrenalin, which is a modifier of the sympathetic function, it produces tachycardia, glycosuria and polyuria. In a third series of cases we find a combination of both groups of phenomena in the same case; we have, then, a form of Graves's disease which is both vagotonic and sympathicotonic. According to

the degree of hyperexcitability of each of the nerves the oculocardiac reflex denotes a diminution in the excitability of the pneumogastric nerve without any alteration in the state of the sympathetic nerve.

Three cases of multiple sclerosis were examined: In 2 the oculocardiac reflex was absent. In 1 the reflex was present and without any alteration. Considering the variability in the localization of the lesions in this affection the diversity of the oculocardiac reflex is readily explained. There was undoubtedly a plaque of sclerosis in the medullary center of the reflex arc in the first 2 cases and no lesion whatsoever in the center and in the centripetal or centrifugal portions of the reflex arc in the third case.

Twelve cases of old hemiplegia were examined with the following results: In 8 the oculocardiac reflex was absent when tested by ocular compression on the paralyzed side and normal when tested on the normal side. In 2 cases it was abolished when binocular compression was carried out. In 2 cases of very mild hemiplegia the oculocardiac reflex remained normal. These findings are suggestive not only with regard to the diagnosis of a unilateral lesion of the motor tract but also to the differentiation of an organic from a functional nervous disorder.

In view of the clinical observations concerning the oculocardiac reflex, in view of the associated phenomena observed during the ocular compression, in view of the pathogenesis of the reflex in which the medulla is considered as the center of the reflex, the question arises whether alterations in the function of the various portions of the reflex arc as obtained by ocular compressions could not be utilized in the treatment of some manifestations having its origin in the medulla. With this idea in mind the writer attempted to modify tachycardias, tremor, hiccough, persistent sneezing, hysteric paroxysms and the phenomena of thyroidism.

In anxiety neurosis the patients not infrequently complain of paroxysms of tachycardia. Five such cases were kept under observation. Besides the mental attitude the tachycardia was

particularly distressing, and indeed intensified the patient's hypochondriac ideas. The patients (4 females and 1 male) were instructed during the attacks of cardiac palpitation to lie down and with the index fingers compress both eyes during one-half minute. Relief was obtained in every instance. The pulsation decreased considerably and remained so for several hours until the next attack. The success was so striking that the patients never failed to have recourse to ocular compression as soon as the attacks of tachycardia made their appearance. They learned through experience how deep the compression should be made in order to obtain satisfactory results. It is to be borne in mind that in each of the 5 cases there was no organic lesion of the heart.

The ocular compression did not remove the cardiac neurosis, but whenever the cardiac irritation made its appearance it diminished considerably the precipitated heart action, and not only gave subjective relief but also exercised a sedative action on the cardiac muscle. The total disappearance of the cardiac phenomena took place only when the anxiety neurosis through other therapeutic channels was removed. The beneficial effect of the ocular compression was strikingly evident.

The same experience was observed in paroxysms of tachycardia in 7 cases of hysteria. Two of them were particularly pronounced. The patients' pulsations would reach during the attacks 160 and 180 respectively. Ocular compression succeeded in decreasing the number of beats to 86 and 72 respectively. In the entire group the oculocardiac reflex was utilized to the greatest advantage. The patients learned how to produce it and to what extent to press the eyeballs into the orbits.

Of special interest the procedure appeared to the writer in 1 case of hiccough and in the 2 cases of persistent sneezing. The first case is that of a clergyman, who being of a neuropathic make-up developed a fear every time he had to deliver a sermon. He trembled, became pale and felt weak. This would last a few moments, after which hiccough would make its appearance. The latter would last several hours, and on several occasions

two days. Neither bromides nor opiates succeeded in arresting the distressing manifestation. Ocular compression was resorted to. Surprisingly it gave the patient considerable relief on many occasions, and finally the patient succeeded in arresting the hiccough completely. According to his statement the arrest of the disorder was arrived at after several attempts, and only when he learned how long to continue the compression and how deeply to press the eyeballs into the orbits.

Persistent sneezing followed in one case an attack of grippe of six weeks' duration and in the other an acute rhinitis. The paroxysms of sneezing occurred at irregular intervals and lasted for a period of thirty minutes to two hours, with intervals of about five to ten minutes. Inhalations of various kinds, sedatives and local applications have all been tried during the paroxysms, but in vain. Finally, ocular compression was resorted to as a palliative to check the sneezing. It gave surprisingly good results. The patients learned how strongly to press upon the eyeballs. At no time was the procedure considered curative, but it was extremely helpful during the attacks of sneezing, as it succeeded in checking it very early in the attack. The patient eventually recovered.

Two cases with symptoms of *thyroidism* came under observation. They were females with large goiters. They were subject to attacks of tachycardia with chills and a sense of impending death. A fine tremor of the hands was also observable. Ocular compression was applied in these cases as a tentative measure during the attacks for relief from the vagotonic manifestations, which evidently were related to the dysthyroidism. The method was considered, of course, as palliative. The very evident relief obtained from it at each attack was too striking to ignore its usefulness, and the patients applied it very skilfully. They learned the details of the manipulation and had recourse to it promptly in the early phase of each attack. The relief consisted of a diminution of the tachycardia, of a lessening of cardiac compression and of a decrease of respiratory movements which always accompanied the attacks in an exaggerated manner.

One case of tremor was observed in a middle-aged man who was addicted to the use of alcohol in a periodic manner. After an excess the tremor would become markedly increased and last two or three weeks. Ocular compression during that period without any medication and practised several times a day considerably diminished the intensity of the tremor and shortened the period of the usual increase; while formerly it lasted from eight to twenty days, with ocular compression the tremor would disappear at the end of two or three days. The beneficial effect of the procedure was self-evident.

A young girl, aged nineteen years, suffered from various phobias, particularly from fear of becoming insane. One of her sisters was committed to an institution and her father had outbreaks of depression. She was employed as a bookkeeper and worked with great application. She suffered frequently from headache, and when the latter became intense there would be also dizziness. It is the latter symptom that led her to the idea of "losing her mind." She read a good deal on the subject of mental disorders in popular books. In view of the family history she developed the above-mentioned phobia. Every time the headache and dizziness would make their appearance the patient would be thrown into a state of panic, her heart would palpitate with great rapidity and she would feel oppressed. At that juncture ocular compression was resorted to, not with the expectation of removing the severe headache but of relieving the tachycardia. Each such attempt proved to be successful. The decrease of the heart-beats was from 120 to 86 and later to 72. The psychic effect of the latter improvement was very satisfactory, as it enabled the patient to remove the idea of an existing cardiac affection, which she entertained for a long time prior to the use of ocular compression.

The oculocardiac reflex is a new acquisition in nosology. In a number of instances it has an important diagnostic value. Its presence or absence may sometimes lead to the recognition of a serious malady in its early phase, while other symptoms are still absent. The lesion may be localized in any portion of the

reflex arc from the ocular branches of the trigeminus through the medulla as its center and ending with the pneumogastric or sympathetic nerves. The degree of intensity of this reflex is also an aid to the diagnosis. Finally the therapeutic value of the reflex is self-evident. It is true that the relief obtained during the procedure of elicitation of it in tachycardia and other non-organic disorders may be of psychic origin, nevertheless the improvement is so manifest that its application is not only warranted, but also indicated.

REPORT OF A CASE OF CARCINOMA OF THE FUNDUS UTERI WHICH HAD BEEN TREATED BY RADIUM UNDER THE DIAGNOSIS OF FIBROID; RECOVERY AFTER HYSTERECTOMY[1]

By ASTLEY P. C. ASHHURST, M.D.

AND

C. Y. WHITE, M.D.

Lucy M., aged fifty-two years, unmarried, weight 43 kilograms (95 pounds), height 160 cm. (5 feet 4 inches), was admitted to the Episcopal Hospital, under Dr. Ashhurst's care, November 6, 1920.

Her *family history* was negative.

Her *personal history* showed that she had had the usual diseases of childhood, but was in fair general health until twenty years ago, when she suffered a "nervous breakdown," and since this time she had been an invalid, though she had not had any serious illness. Her heaviest weight had been 47.5 kilograms (105 pounds).

Her *present illness* began about three years ago, when menstrual disturbances first appeared. Her menstruation, which commenced at fifteen years of age, was regular up to three years ago, and though at times painful, the bleeding always had been moderate in quantity, and had lasted only four or five days. In March, 1918, however, she began having uterine hemorrhages, and after three or four months of bleeding she was admitted to the Cooper Hospital, Camden, N. J., where her uterus was curetted. (In-

[1] Read June 1, 1921.

quiry of this hospital in May, 1921, as to whether any pathologic examination was made of the tissue obtained, was answered as follows by Dr. Thomas B. Lee: "The report of the examination of the scrapings I will give you verbatim: 'Chronic hyperplastic endometritis. There is a great excess of glandular substance, the interglandular tissue being almost absent in some areas, but there is no evidence of malignancy at present. Frank B. Lynch, Jr., M.D.'"

The hemorrhage stopped for a few months, but then recommenced. In June, 1919, she was under the care of an experienced gynecologist, who made a diagnosis of uterine myoma, and who gave her radium treatment. Sufficient tissue for microscopic examination was not obtained at this time by curettage. No bleeding occurred after this until March, 1920, a free interval of eight months.

Since March, 1920 (eight months previous to admission to the Episcopal Hospital), she had been bleeding almost continuously, in small quantities; there had been a constant vaginal discharge, and she had been more of an invalid than in her previous state of health.

On April 8, 1920, the same surgeon who had made the radium application amputated her left breast. His preoperative diagnosis was "chronic cystic mastitis," but a microscopic study showed the tumor to be a fibroadenoma. The patient had noticed this tumor about a month only before the operation, but it seemed to grow rapidly, and was the size of a small egg when removed. She did not recuperate well from this operation.

She spent the summer of 1920 at the seashore, in the hope that the bleeding and discharge would stop with an improvement in her general health. She gained in weight from 43 kilograms to 47.5 kilograms (95 to 105 pounds) while away, and was in comparatively good health for her. She was able to do a little tutoring, being transported to and from her place of employment in her employer's automobile. A week after her return home she was again admitted to a hospital in October, 1920. During the three weeks she remained there she lost all the weight she

had gained during the summer. She was then transferred to the Episcopal Hospital, the sole reason for her transfer being a financial one, as the Board of Managers of the latter hospital generously placed a private room at her disposal *gratis*. Indeed, the superintendent of the hospital was given to understand by those seeking her admission that hers was "a hopeless case," and that she could not live more than a few weeks.

The physician under whose care she had been from June, 1919, to October, 1920, who was consulted by Dr. Ashhurst, confirmed by telephone conversation the essential points of the above history, and gave the additional information that the uterine cavity, which measured 9 cm. (3½ inches) in June, 1919, was smaller in September, 1919, after the radium treatment. When asked what was his objection to doing a hysterectomy in the case of this patient, he replied he considered it unnecessary, as further radium treatment should prove curative; and instanced as an additional reason this patient's poor recuperative power: he considered her a poor operative risk.

On admission to the Episcopal Hospital, November 6, 1920, the patient was found to be a frail, worried-looking individual, rather anemic and very thin, typical of a neurasthenic. She was very emotional and anticipated death as the only relief from her suffering, which she alleged to be great.

Urinalysis was negative except for hyaline and light granular casts. The quantity up to the time of the hysterectomy varied from 300 to 1000 cc (10 to 32 ounces) daily. After operation it varied from 500 to 1300 cc (16 to 44 ounces) daily. A phthalein test before operation showed excretion of 15 per cent during the first hour and of 5 per cent during the second hour: total, 20 per cent.

Blood examination showed red blood cells numbering 4,520,000; white blood cells, 11,240 (polymorphonuclears, 70 per cent; lymphocytes, 20 per cent).

Fluoroscopic examination of the gastrointestinal tract by Dr. Bromer was negative except for moderate gastroptosis and coloptosis.

Vaginal examination showed a moderately enlarged but freely movable uterus, with constant slight bleeding. The cervix felt normal.

Dr. M. H. Fussell saw the patient in consultation and furnished the following notes: "The thyroid is somewhat enlarged. There is considerable muscular tremor. The heart dulness extends to the right edge of the sternum and the left midclavicular line. At the aortic area is a systolic murmur; over the body of the heart is a systolic murmur which is conducted to the axilla. There is no arrhythmia, no diastolic or presystolic murmur. Lifting the arm above the head does not lessen the impulse of the radial pulse." Dr. Fussell advised against any operation on account of the condition of the patient's heart, unless it should be the introduction of a radium tube, which could be done under a brief nitrous-oxide anesthesia.

In spite of these unfavorable opinions Dr. Ashhurst believed that the patient would support a hysterectomy under general anesthesia, and from his own examination of her heart he believed ether would be preferable to gas, even in spite of the apparently precarious condition of the patient's kidneys. Therefore she was advised to have the uterus removed, and for the following reasons: Here was an elderly single woman with a diseased uterus (the preoperative diagnosis was fibroid uterus), who had been treated by radium with only temporary benefit, and who was steadily losing ground; she was no longer in a condition for temporizing, but required radical treatment to ensure removal of the disease. Though radium treatment might sometimes be justifiable in the case of a comparatively young woman with a myomatous uterus, he considered certainly that in older women hysterectomy afforded a more certain and therefore a more desirable remedy.

Operation was accordingly done, under ether anesthesia, on November 26, 1920, three weeks after the patient's admission. The abdomen was opened by a left paramedian incision 18 cm. in length. The omentum was adherent at one point to the anterior parietal peritoneum, but this adhesion was not disturbed nor was

the appendix vermiformis removed, as any prolongation of the operation was deemed inadvisable. The uterus, about twice its natural size, was free from adhesions, and presented a mass just posterior to the fundus. The fundus was grasped with volsellum forceps and the uterus was drawn into the wound, the remainder of the peritoneal cavity being excluded by gauze pads. The volsellum forceps tore partly out of the fundus (which was then entirely outside the abdominal wound), disclosing a gray, friable and malignant-looking uterine wall. The uterus with its cervix was removed, but the tubes and ovaries were left, as it was not desired to increase the patient's neurasthenia by precipitating the menopause. The stumps of the round and broad ligaments were implanted into the vaginal vault, which was closed with interrupted chromic-gut sutures. The abdominal wound was closed in layers without drainage.

The patient stood the operation without any unfavorable symptoms referable to her heart or kidneys, and except for nausea and occasional vomiting, prolonged for a period of two days, made an uneventful recovery. She left her bed twenty-five days after operation, and before her discharge from the hospital, on January 15, 1921, she had learned that she could walk up and down stairs and take strolls about the hospital grounds. Her weight on discharge was 44.5 kilograms (98 pounds).

Since returning to her home she has been able to resume the normal life of a woman of her age and station. She reported in May, 1921 (six months after hysterectomy), looking the picture of health, and said that she felt perfectly well, weighed over 49 kilograms (108 pounds), and was about to accept a situation as governess. (Postscript: Under date of February 22, 1922, fifteen months after operation, she writes, "I am very well indeed and weigh 112 pounds" (50.73 kilograms.)

Pathologic Report on the Uterus. *Gross Appearance.* The uterus is about twice its normal size: Its weight is 78 gm. and its dimensions 9 by 8 by 5 cm. It presents a tumor at the fundus, involving the posterior more than the anterior wall. The outer surface of the uterus is smooth with the exception of

the site of its normal attachments, which have been removed by operation. The thickness of the wall at the site of the tumor is 25 mm., that of the unaffected uterine wall is 17 mm. This thickening is due not only to the growth on the mucous surface but also to involvement of the muscular wall in the tumor. The uterine wall does not show any evidence of fibromata.

On the mucous surface of the uterus the tumor extends from the fundus on the posterior wall to a point 30 mm. from the internal os, and on the anterior wall to a point 55 mm. from the internal os. The dimensions of the tumor on the mucous surface of the uterus are 45 mm. on the posterior wall and 20 mm. on the anterior wall. The mucous surface of the tumor is ulcerated, and this ulceration is deep in some areas, showing undoubted evidence of necrosis. The endometrium over the tumor is generally roughened, with folded cauliflower-like projections. The membrane elsewhere is injected and the tumor mass is friable.

Microscopic. The growth is typical of adenocarcinoma. It infiltrates into the muscular wall in all directions with the formation of large pockets of carcinomatous tissue. It shows no evidence of treatment (by radium), there being no increase of fibrous or cicatrizing tissue.

Diagnosis. Adenocarcinoma.

DISCUSSION

Dr. John G. Clark: Dr. Ashhurst has laid before you the report of a case recently treated in my department at the University Hospital. With my history of the patient before me, perhaps I may correct some discrepancies in his history as set forth by him. As I understand the report the patient was referred to the Episcopal Hospital as an incurable case. This is an error, as the patient had been seen by me in consultation at the Chestnut Hill Hospital after she had experienced a recurrence of uterine bleeding one year after irradiation. I very strongly urged her to reënter the semiprivate ward at the University Hospital, where on June 27, 1919, she had had an irradiation for a menorrhagia of several months' standing with a continuous flow for six weeks pre-

ceding her entrance to the hospital. The history leading up to the treatment was typical of a myoma of the uterus, in that there was no spotting between the periods. She also had given me the history of having had a curettage in Camden and that the result of the microscopic examination of the endometrial debris was negative so far as carcinoma was concerned. The uterus was enlarged to about the size of a small orange and the depth was three and one-half inches. A thorough curettage failed to bring away a sufficient amount of endometrium for microscopic study.

With the previous history of benignancy the presence of a uniform enlargement of the uterus, the menorrhagia and the absence of any intermenstrual spotting I believe that any clinician would consider the case a myoma of the uterus. No other means, I am sure, could have been employed to make more accurate the diagnosis.

Subsequent to this the patient had no further bleeding, picked up wonderfully in health and was not seen until April 4 of the following year. She had had no further flow until three weeks previous to this consultation, when she had had a very slight spotting with a slight yellowish leucorrheal discharge. This, however, is not an infrequent occurrence in cases of myoma of the uterus where radium has been employed. At that time a small mass had developed in the left breast, which was removed and was found to be a fibroadenoma without a trace of malignancy. Again in June the patient had a recurrence of bloody flow, never amounting to more than one napkin. She passed through the summer and early in the fall was admitted to the Chestnut Hill Hospital for pain and continuous flow. At this time I saw the patient and urged her to reenter the University Hospital for treatment either by irradiation or by operation, as would seem best when more carefully examined.

In cases of this character we again performed a curettage when, with the very patent evidence which the specimen showed when removed by Dr. Ashhurst, carcinoma would undoubtedly have been diagnosticated. Under such conditions naturally the radical operation would have been advised.

Dr. Ashhurst states that it is valuable to have clinical errors pointed out in order that profit may come from the discussion. I quite agree with him that nothing is more helpful provided that some definite point of value may be obtained from such a discussion. Frankly, however, I am at a complete loss to understand what particular point of value comes out in this paper. Possibly Dr. Ashhurst himself is open to criticism. He tells us that he did not remove the ovaries and tubes but clamped them off on the uterine side, leaving them *in situ* in order that the patient should not have a severe menopause. As to the patient's age, she was

fifty-two years old at the time my history was taken. How can a woman of fifty-four years of age, which she must have been when Dr. Ashhurst operated upon her, have an amelioration of menopausal symptoms? Will not the dangers from a recurrence of the cancer at the site where he has clamped off the ligamentary attachments offset any possible advantage which might accrue from such a procedure even in a young woman where the wisdom of ameliorating a menopause is unquestioned. I would say, therefore, that the criticism is a very striking one relative to this plan of treatment. With the most careful clinical study of over 500 cases of irradiation for small fibroids in my department at the University Hospital we have made errors which might have been corrected, but in this instance I would be very happy indeed if Dr. Ashhurst will point out in any way by which such an error as this might have been obviated. Certainly, to remove all uteri in women at this age who have menstrual disturbances with even the small mortality which must attend this surgical procedure would to my mind be a most unsurgical and unscientific method of reaching the desired end. One of the accepted clinical laws relative to myomata is that the hemorrhage is of a periodic type and always occurs at the menstrual time with clean intervals. In this case, up to six weeks previous to this patient's entrance to the University Hospital, there had been a very classical history of fibroid. After reviewing our own treatment of the case and listening to Dr. Ashhurst's criticism, I find nothing in the report that would help one in obviating a similar error in another case of like history. I am particularly anxious, therefore, that Dr. Ashhurst will point out to us what particular object has been gained in the report of this case.

It is my desire to put Dr. Ashhurst straight on one question. He criticizes the use of radium in women at the menopause and advises a hysterectomy, but says he might consider it advisable to use radium in young women who still wish to have children. To irradiate sufficiently to cause the disappearance of a fibroid almost invariably causes sterility, and it is the one class of cases in which we advise operation and not irradiation. Dr. Ashhurst has stated that he does not know much about the use of radium. The assertion, therefore, that he would employ radium in a young woman who wishes to have children settles very definitely that he is not in full touch with modern ideas relative to the use of this remedy.

Dr. A. P. C. Ashhurst: Dr. Clark has asked a couple of questions which ought to be answered. The first question that he asked was the object of the report, and by that I know he does not mean to imply it would have been better to leave this case unreported. I like to report

my mistakes in diagnosis and I am sure that Dr. Clark also likes to do the same, not because I can bring forward anything now which would have made a more correct diagnosis possible, but because if we keep at it long enough, some day, in the next hundred years, perhaps, we will. The reason I made a wrong diagnosis was because Dr. Clark made a wrong diagnosis. Dr. Clark asks why I left the tubes and ovaries. Because my diagnosis was fibroids. The only question between Dr. Clark and myself, or between Dr. Clark and Dr. Shoemaker or anyone else, is as to the indications for hysterectomy and for radium. Now I would be willing to admit that Dr. Clark knows a great deal more about the subject of fibroids and carcinoma of the uterus and radium than I do, but I have got to decide things for myself and for my patients, and the view I take is this: That while it might be justifiable to treat by radium innocuous fibroids in young women who were anxious to bear children, it is improper to treat fibroids in elderly females at or past the menopause by radium if there is any reasonable chance that the patients would survive hysterectomy.

THE USE OF IRON IN POSTHEMORRHAGIC ANEMIAS[1]

By JOHN H. MUSSER, Jr., M.D.

Last year, before the May meeting of the College of Physicians, Dr. Whipple presented a paper in which he stated that according to the series of experiments which he and his co-workers had carried out in California they had arrived at the conclusion that in the treatment of ordinary anemia inorganic iron has little if any effect on the regeneration of the blood without adequate diet, and they held that it is impossible to assume without positive proof that inorganic iron is of value in the treatment of simple anemia. This statement is decidedly contrary to the usually accepted idea that iron has a very distinct value in the treatment of anemia. There is a long history to the controversy over the use of iron which has held the medical profession from 1746 until 1906, when it was definitely assumed by most men that organic iron could be converted into hemoglobin. In order to test out these theories it was thought that it would be of value to study animals which had been repeatedly deprived of small amounts of blood and who had been thus rendered anemic. Anemia of this type undoubtedly resembles very closely the type of anemia which we see clinically after the loss of small amounts of blood.

Methods. The animals were bled at varying intervals and the test animals were put upon iron. Following the administration of the iron the following studies were undertaken: Hemoglobin estimation; red and white cell counts; differential

[1] Read June 1, 1921.

count; resistance of the red cells; percentage of skeined cells; determination of the total blood volume. The animals were given iron in the form of equal parts of ferrous sulphate and sodium bicarbonate, and a dose was given which was equivalent to that of 1 gram a day to an individual of 65 kilos.

Experimental Data. In the first experiment two splenectomized dogs were employed that had been rendered anemic as a result of weekly bleedings of 100 cc for two and a half months. These dogs were observed for a period of nearly two months; blood counts were made every second or third day. In this experiment we may say briefly that the dog that was given the iron returned more rapidly toward normal figures than did the control dog. However, the control animal started with a lower figure than the test animal, and both animals obtained the highest figures at about the same time.

In the second experiment dogs were used that had not been splenectomized. The experiment was somewhat similar to the first. In this experiment the two animals approached normal at approximately the same time, but the return of the control animal to normal was more rapid and more complete.

In the third experiment two dogs that had been bled over a short period of time were bled large quantities for six consecutive days and were then followed as in the other experiments. In this experiment the control dog apparently regenerated more rapidly than did the test animal.

In the last experiment (No. 4) two animals were selected that had been splenectomized and then rendered anemic by hemorrhage repeated on two successive days. In these two animals it can be said that both returned to normal in the same length of time, and the iron had practically little effect on them.

Discussion. The results of these experiments would seem to substantiate the contention of Dr. Whipple that under ordinary circumstances the giving of inorganic iron does not have a particularly marked effect upon blood regeneration and the correction of anemia in experimental dogs. It may be contended that the return to normal in these animals is so rapid that the iron

can have but little effect when nature is taking care of the anemia so thoroughly. But in two of the dogs which had been rendered anemic by repeated bleedings and by a long-time splenectomy the return to normal was relatively slow; yet in neither the control nor in the experimental dog was there any obvious or material difference in the rapidity of the regeneration of the red blood cells or hemoglobin. Differences, of course, exist between the dog taking iron and the control, but only such as would be expected. It would be almost impossible to obtain animals which were alike in every respect. The hemopoietic systems of no two animals will respond in exactly the same manner. In considering experimental work of this type, various factors must be taken into consideration. The resistance of the red cells to hypotonic salt solution in some animals is greater than in others, and this must play some factor in altering the course of anemia. In some animals the response of the marrow and the stimulation of hemorrhage is greater than in other animals. This can be demonstrated by the skein cells. In some animals the blood volume is greater and better sustained than in others. Lastly, there is no absolute mean normal count, as these various factors produce differences in the hemoglobin and red cell counts in the different dogs.

SUMMARY. In two of four experiments dogs receiving iron regenerated blood more rapidly than did their controls. In the other two experiments the control dogs apparently improved more quickly than did the test dogs, and this improvement is found to be particularly definite when analyzed in relation to the blood-volume changes.

CONCLUSION. The administration of inorganic iron cannot be said to produce any constant alteration in the course of an experimental hemorrhagic anemia.

DISCUSSION

Dr. Hobart A. Hare: As the Fellows of the College may know, in the current issue of *Internal Medicine* there is a paper in which the use of iron is said to be futile. The views expressed are very much more positive than are Dr. Musser's. Papers of this kind, particularly those of Whipple, illustrate something which I think we must all be on our guard against more or less, that is experiments upon a few animals, even if these experiments are surrounded by scientific accuracy, and then having deductions drawn from them which seem to contradict the experience of physicians for generations. It is perfectly true that experiments upon animals are of great value in directing our ideas concerning the action of drugs, but the function of the modern pharmacologist seems to be to disprove everything the clinician believes in and offer him nothing in its place. He is somewhat in the position of the modern laboratory physician with that of the atheist, who says there is no God. It is inconceivable to me that where hundreds or thousands of physicians have thought they saw definite proof of benefit from the administration of iron, that all these men could have been utterly wrong in their observation. The pharmacologist should under these circumstances, when diametrically opposed to the clinician, publish his results and then seek for further explanation as to where his error may lie or where the error of the clinician may lie. Now we have an illustration of that in calomel. So far as I know every paper published concerning the influence of calomel on the liver shows that calomel does not increase the flow of bile. This holds true as to animals or in human beings. In many cases with biliary fistula doses of calomel are without the slightest increase in the flow of bile, but I think there are few Fellows of this College who do not believe that calomel has some influence over the liver. It will take many papers to make these Fellows consider calomel is useless in what may be called hepatic torpor. Some years ago a paper was published to the effect that chloride of ammonium given to dogs had no effect whatever on the mucous membranes of the dog, and therefore the laboratory worker issued the edict that the use of this drug in human beings was futile. I have great confidence in experimentation. In my early days I did a great deal of it, so I am the last to throw a stone at it. There are a number of factors that come into this work. In the first place, the difference between animals and man; in the second place, the age of the animal. In the last paper by Whipple he stated they used puppies which they reared themselves. This possibly does not hold against Dr. Musser's research. An animal eight to ten years old is as old as a man of seventy to eighty years. When we come to the administration

of iron we must know something of the mucous membrane of the stomach and bowel, and when we accept these comparatively modern findings, if correct, we must throw aside not only all clinical work referred to but throw aside Stockman's work and all the other clinical work which has been done in this matter. In other words, it may be that producing hemorrhages in an animal which does result in secondary anemia does not result in producing the same conditions in the body which exist when iron does good in ordinary secondary anemias arising from other causes than hemorrhage. I am much interested in what Dr. Musser has said, because evidently his researches leave us a little less on the fence. I understood him to say the iron seemed to distinctly improve the condition. There is a difference in the alimentary canal of the dog and man, one having a very short one and the other a very long one, and iron is largely eliminated by the mucous membrane of the colon, and it is possible in the dog that the process of absorption and elimination of iron is quite different from that existing in the human being. We also know that the hypodermic administration of iron in some individuals will be followed by rapid regeneration of blood and secondary anemia, whereas gastric administration will not. Various explanations have been made as to this in gastric catarrah. I missed some of Dr. Musser's paper. I heard him say he gave the equivalent of 1 gm. to each 65 kilos. weight of dog. This brings up the interesting point that it is the common practice to administer large doses of iron which actually interfere with absorption of the drug by producing constipation. It reminds me of Sir Andrew Clark's statement that if he had to treat anemia he would rather treat it with laxatives than with iron. There are only 30 to 40 grains in the body, and the common practice of administering full doses several times a day results in twenty-four to forty-eight hours in giving all the iron the body can use in weeks. Under these circumstances it has to be stored by the body. A large amount is stored in the liver and a large amount is eliminated by the lower bowel. If these investigations are correct the whole mass of the medical profession has been wrong in administering iron in anemia and has been utterly mistaken in its clinical observations. Thousands of men are in error or else there is some explanation which must be forthcoming.

Dr. Musser, (closing): Iron was given in the form of Blaud's pills. I think Dr. Hare's criticisms are pertinent. To my mind the fallacy of Whipple's work is in comparing an acute hemorrhagic anemia with the average anemia seen in clinical experience. In other words, anemia of the hemorrhagic type is very much the exception, and we have to take into consideration the factor of damaged blood formation. It is simply a quantitative question. The other is qualitative.

THE SURGICAL TREATMENT OF PULMONARY TUBERCULOSIS[1]

By H. C. JACOBAEUS, M.D.
STOCKHOLM, SWEDEN

It was at first my intention to speak of but one operation for pulmonary tuberculosis, namely, the burning off of adhesions under the guidance of the thoracoscope; but as I have noticed during my stay in America that the surgical treatment of tuberculosis in this country differs to a certain extent from the one generally used in Europe, I may be permitted to say a few words in regard to other operations as well.

Pneumothorax Treatment. In Europe tuberculosis of the bones and the joints is rarely, if at all, treated by surgical measures, while, on the other hand, pulmonary tuberculosis is very frequently treated by means of operations, the object of which is always to bring the affected lung to collapse. Naturally the well-known "pneumothorax treatment" is the one most commonly employed, and as it seems widely used also in this country it is no doubt superfluous to describe it in detail. I only wish to mention that during the last few years a number of statistics have been published in Europe as to the results of pneumothorax treatment. All of them indicate that the immediate effect on the pulmonary tuberculosis is very favorable, but that the later results, after some years, are not so good for the lower classes as for the well-to-do patients who are treated in private sanatoria. This is, of course, due to the difficulty or even the impossibility of keeping the poor under treatment for a sufficient length of time.

[1] The Mütter Lecture. Read November 2, 1921.

THE THORACOPLASTIC OPERATION. Another surgical measure which is now being widely used in Europe, and particularly in the Scandinavian countries, is the thoracoplastic operation, with removal of all of the ribs except the twelfth (Estlander, Sauerbruch). To illustrate how frequently this operation is performed, I may mention that Key, of Stockholm, during the last few years, has operated 50 cases; Prof. Bull, of Christiania, about the same number; and Saugmann, of Denmark, not less than 100 cases in a sanatorium of only 120 beds. The technic of these three operators differs somewhat. Key and Bull operate in two stages, removing the fifth or sixth lower ribs first and in two or three weeks later the rest, including the first rib, which technically is quite difficult to remove. Saugmann does the entire thoracoplastic operation in one stage when the condition of the patient allows.

The thoracoplastic operation is indicated particularly in those unilateral cases in which the adhesions are so extensive as to preclude a pneumothorax treatment. As it is comparatively rare, however, to find one lung gravely affected while the other is entirely untouched, we extend the indications to include also some cases in which the other lung is partly diseased. To what degree the better lung may be affected without contraindicating the operation is difficult to decide, and every individual case must be considered on its own merits. Not only the topographic extension of the pathologic changes in the better lung is of importance in formulating the indications, but also the general condition of the patient and the type of tuberculosis present, *i.e.*, whether it is of the acute or the chronic form. These latter factors are of greater weight in thoracoplasty than in the pneumothorax treatment, because of the extensive nature of the operation. In Stockholm, where Dr. Key and I are working together, we usually take the following precautions: We make a very exact physical and *x*-ray examination and send the patient to a sanatorium for about six months; on his return we examine him again very carefully, and if we find that the better lung is not any worse off than at the earlier examination, we operate. Nevertheless, and in spite of these precautions, we have had some failures. In one case the patient was in very good condition when we under-

took the operation, but already, after the first stage, the tuberculous process flared up in the better lung and the patient died after three or four weeks. In another case, however, in which we hesitated to operate because of a slight aggravation of the better lung, we finally consented on the patient's insistence to be operated and got an excellent result. This goes to show how difficult it is to determine the indications correctly. The best results have been obtained by us in those chronic cases in which there are large cavities and obvious shrinking of the chest, with the mediastinum, the heart and the trachea pulled over to the affected side.

In cases in which the tuberculous process is not confined to the lungs alone we believe it futile to perform this extensive operation if the intestines are simultaneously affected, but do not consider tuberculosis of the larynx as a contraindication. Two cases were operated by us in which nephrosis was present, with 6 or 8 gm. of albumin per liter of urine and with good kidney function. In both instances there was an exacerbation of the kidney lesion immediately after the first operation, and the patients died from anuria within a week. We are therefore inclined to consider the presence of nephrosis as one of the most important contraindications.

In a few cases we did a partial thoracoplastic operation. In one instance there was a large cavity in the apex while the rest of the lung was in good condition, and therefore only the five upper ribs were resected. After six months the expectoration had ceased and the patient was symptom-free. In our estimation the free dissection of the apex and the "Plombierung" with paraffin, as advocated by Bär, of Switzerland, in these cases, are not necessary; even without these measures good results will be obtained if the resection of the ribs is radically made.

The phrenic nerve was resected by us in some cases, thus causing a paralysis and a bulging upward of the corresponding part of the diaphragm. No beneficial effects were observed from this procedure, and we consider it of no practical value.

As regards the results of the thoracoplastic operation, we have had an immediate mortality of about 10 per cent. No exact

figures can be given as to permanent results, but we believe that we have had 40 to 50 per cent absolute cures for several years, which must be regarded as satisfactory when it is considered that these patients are advanced cases with very bad prognoses. The results in Christiania have been about the same as in our clinic in Stockholm.

THE CAUTERIZATION OF ADHESIONS UNDER THE GUIDANCE OF THE THORACOSCOPE. I will now proceed to the description of my own operation for completing the pneumothorax treatment in cases in which string-like adhesions prevent the collapse of the lung.

For the last ten years I have practised endoscopy[1] of the peritoneal and the pleural cavities. To begin with I was only interested in the diagnostic advantages that could be gained by such a method. In cases of ascites, after tapping and replacing by air, I could get a clear and perspicuous picture of the abdominal organs through the endoscope. With regard to the liver there was no difficulty in diagnosticating cirrhosis, malignant tumor, Pick's disease, liver syphilis, etc.; in carcinoma and tuberculosis of the peritoneum I could indicate changes characteristic for these diseases.

Without doubt, however, the predominant interest of these endoscopies centers around the examination of the pleural cavities, the so-called thoracoscopy. With regard to the chest cavity we have, as we know, nothing corresponding to the exploratory laparotomy of the abdominal cavity. Furthermore, the thoracoscopy is so simple a method that it can be performed without inconvenience in every case of exudative pleurisy which is subject to thoracocentesis. The ocular examination of the pleural surfaces is in most cases relatively complete. In cases of so-called idiopathic pleurisy I have also succeeded in finding distinct tuberculous nodules in most of them. For the differential diagnosis between tumors and pleurisy of other origin the thoracoscopy is of no small value. After some practice it is at least possible, with some certainty, to differentiate between tumor-

[1] The instruments are made by G. Tiemann, 107 E. 98th Street, New York City

metastases and tubercular changes. In doubtful cases one can by test—excision under guidance of the thoracoscope—decide the nature of the pleurisy in the special case. Even solid intrathoracic tumors can be observed by thoracoscopy and their relations to neighboring organs—the lung, the thorax wall, etc.—can be determined much more clearly than by any other method.

From a practical point of view the most important field for the use of the thoracoscope is no doubt operation which can be performed directly under the guidance of this method. While working with the thoracoscope in cases of pulmonary tuberculosis subjected to the pneumothorax treatment, I noticed that a specially clear picture was obtained of existing string- or membrane-like adhesions between the lung and the thorax wall. This caused me to try to work out a method to remove such adhesions under the guidance of the thoracoscope. It is a well-known experience that a single string-shaped adhesion which causes the lung to be attached to the thorax wall may prevent a cavity from collapsing and thus may bring failure to the entire pneumothorax treatment. A recently published paper by Gravesen, from Saugmann's sanatorium, contains the following table, which proves the injurious effects of these adhesions.

TABLE I.—CASES WITH COMPLETE PNEUMOTHORAX WITHOUT ADHESIONS THREE TO THIRTEEN YEARS AFTER BEING DISCHARGED

		Per cent.
Able to work	23	70.2
Not able to work because of tuberculosis	1	2.1
Died from tuberculosis	11	23.4
Died from other causes	1	2.1
Unknown	1	2.1

CASES WITH COMPLETE PNEUMOTHORAX BUT WITH LOCALIZED EXTENDED ADHESIONS.

		Per cent.
Able to work	14	33.33
Died from tuberculosis	28	66.67

CASES WITH INCOMPLETE PNEUMOTHORAX WITH LARGER OR SMALLER EXTENDED ADHESIONS

		Per cent.
Able to work	5	11.1
Died from tuberculosis	39	86.7
Died from other causes	1	2.2

The injurious influence of the adhesions is simply demonstrated by this table, which also gives one a conception of their frequency. I have not the time here to enter into the different methods attempted by others to remove such adhesions. I can only say that none of them has proven to be of any greater practical importance.

As it was rather easy to observe the above-mentioned adhesions through the thoracoscope, it was believed best to cauterize them by introducing a galvanocautery into the chest under the guidance of the thoracoscope. The first attempts were made in 1913, and since then I have performed 55 such operations, of which I will briefly relate the results of 50. The operation has been performed in 21 cases by Saugmann; of these his assistant Gravesen has reported 16; 12 cases have been reported by Holmboe and 20 cases by Skärgard; 6 by Sömme, 6 by Betrup Hansen, 3 by Christoffersen and 2 by Dahlstedt. At the present time certainly far more than 100 operations have been performed. I practically always introduce the thoracoscope under local anesthesia, posteriorly somewhat higher up when the adhesions are at the lung apex and lower down when they are in the lower part of the pleural cavity.

Of still more importance is the selection of the place where to introduce the galvanocautery. Because the adhesions in most cases are situated upward and laterally I have usually introduced the galvanocautery in the anterior axillary line in the seventh, eighth or ninth intercostal space. When there are apex adhesions I introduce it still higher up in the axillary line, and in case of diaphragm adhesions in the lower part of the thorax wall. After having introduced the galvanocautery in the pleural cavity I arrive at the second and most difficult part of the operation, namely, the handling of the galvanocautery under the guidance of the thoracoscope, and it is for this one needs the most practice. It is not always easy to locate the galvanocautery itself, and its directing and applying on the adhesion require a certain experience. Generally I apply the platinum needle on the narrowest part of the adhesion. In cases in which a cavity in the

lung exists underneath the attachment of an adhesion I perform the cauterization as close to the chest wall as possible. The pain may then at the very moment of the cauterization become rather severe. But, as a rule, the pains are fairly moderate, especially when it is a question of small strings or membranes, which easily are cauterized in a fraction of a minute. Thick, firm, sinewy adhesions offer sometimes a very strong resistance, and I have now and then worked with them for one or two hours. When cauterizing it is of great importance not to have too strong a glow on the galvanocautery, because otherwise a hemorrhage may arise. Only in one of my 55 cases has a hemorrhage of 100 to 200 cc occurred, and from other authors who have used the method only one single case is known to me where a really dangerous hemorrhage occurred, probably caused by too strong a glow. Since then no death caused by hemorrhage in these more than 100 cases has occurred. It seems to me that we are justified in considering this complication not to be of such importance that the operation therefore ought to be abandoned in favorable cases. A certain degree of danger and uncertainty of hemorrhage is, of course, always at hand, but if a slight glow is used the danger ought to be relatively small.

Comments on the Reported Fifty Cases. Complications may arise sooner or later after the operation. A subcutaneous emphysema originating from the puncture opening may occur and may cause some trouble for a day or two, but soon disappears. Of greater importance are the pleuritic exudates which may develop after the operation. Table II gives the different forms which occurred in my cases.

TABLE II

Cases without exudate	25
Cases with slight exudate	15
Cases long lasting exudate and fever	4
Cases long lasting exudate and fever accompanied by empyema	4
Cases with exudate appearing only one to three months after operation	2
Total	50

The first group of cases quite naturally developed very favorably. After a few days of fever the patient had the same low temperature as before the operation. The same can be said about the second group, where we had a small exudate which did not reach above the pleural cupola. After one or two weeks it disappeared without leaving a trace. These pleurisies had therefore no influence on the clinical result, and one is entitled to say that in 40 out of 50 cases the operation had no unfavorable influence on the clinical course. The third group comprises 4 cases in which the exudate, a higher temperature and an apparently bad effect on the general condition remained during four to six weeks following the operation. It was probably due to an ordinary tuberculous pleurisy. In the fourth group, which also comprises 4 cases, the pleurisy was at first of a serous nature, and thus of the same character as in group three, but after one or several months a tuberculous empyema developed. In these cases the complication had such a very unfortunate influence that of these 4 cases 3 ended with death after one or two years, without doubt in no small degree caused by the weakened general condition brought on by the chronic empyema. In the last group the condition was good immediately after the operation, but after a few months an exudate appeared which in both cases turned into empyema. Both patients, nevertheless, gradually improved, so that the prospects for the future are fairly good. Whether the cauterization had anything to do with the pleurisy appearing so late after the operation is, of course, impossible to decide with certainty. An independent development of the empyema is, according to my opinion, probable.

From other statistics one finds that Gravesen in his 16 cases had empyema in 2 cases and serous pleurisy in 4; in Holmboe's 12 cases there was a slight pleurisy in 1 case and in 1 a severe acute pleurisy with empyema and mixed infection, from which the patient died after four or five days. From the above-mentioned experiences it is evident that pleuritic exudate and empyema are the most serious complications of this operation. In my cases the mortality was about 6 per cent, which, though it is high, ought

scarcely to be attributed to the operation alone. On the other hand it is evident that this complication, nevertheless, is not of such importance that the use of the method ought to be excluded from suitable cases.

I will now pass to the credit side of the method and will in Table III show the results in these 50 cases operated by me. I have arranged them in three groups, according to the position of the adhesions in the chest cavity. (Figs. 1, 2 and 3 show the type of apex adhesions; Figs. 4, 5, 6 and 7 show lateral adhesions and Figs. 8 and 9 diaphragm adhesions before and after the burning.)

TABLE III

	Number of cases.	Complete (or for collapse of the lung sufficient) cauterization.	In clinical respect good result.	Incomplete cauterization.
Jacobaeus:				
Apex adhesions . .	5	4	4	1
Lateral adhesions .	42	32	30	10
Diaphragm adhesions	3	3	1	
Holmboe	12	7	7	5
Gravesen (Saugmann) .	16	9	7	7
Total	78	55	49	23

To begin with, we have the apex adhesions. They are mostly short and technically difficult to reach with the galvanocautery. At the cauterization very often pains are felt on account of the proximity to the parietal pleura. In 4 cases out of 5 the operation technically succeeded and a clinically favorable result was obtained. The second group, lateral adhesions, comprises the largest number of cases. In 32 of them the operation technically succeeded, and in all of them except 2 a clinically favorable result was obtained. In these 2 cases, an empyema with the above-mentioned consequences developed.

In the third group, diaphragm adhesions, the technical difficulties have been that the patient during the progress of the cauterization proper must keep the breath, because, otherwise, the adhesion is in constant movement. It is an advantage, however, that in such cases the cauterization is entirely painless.

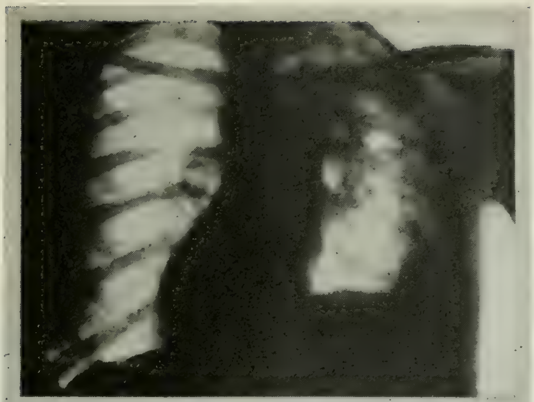


Fig. 1

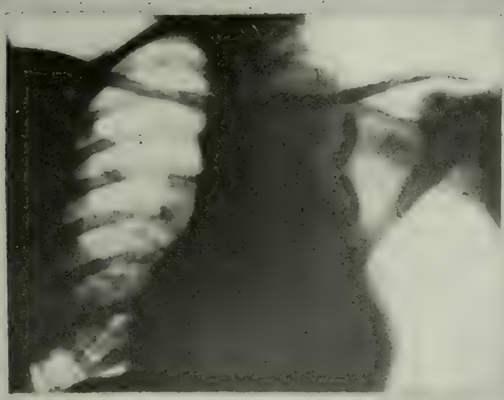


Fig. 2

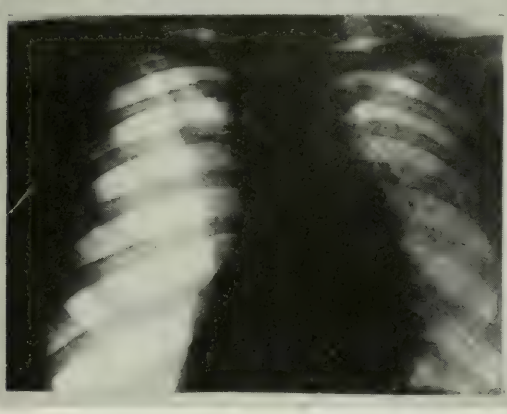


Fig. 3

Figs. 1 and 2.—Cases of unilateral lung tuberculosis before and after the operation. The affected lung has numerous cavities, especially upward. A pain shrinkage of the whole lung has taken place with pulling and expansion of trachea and mediastinum and high leveled diaphragm.

Fig. 2.—This shows the left side considerably sunk in after the operation with disappearance of the cavities.

Fig. 3.—A lung with established pneumothorax which at the apex has a large cavity, prevented from collapsing by an adhesion near the apex and with clearly visible exudate.

In all three cases the operation technically was successful, but only in one case has the clinical result been of value. The lung

FIG. 4

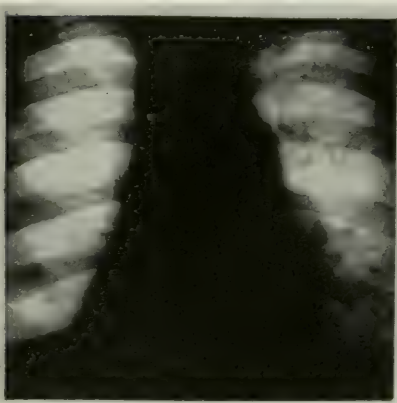
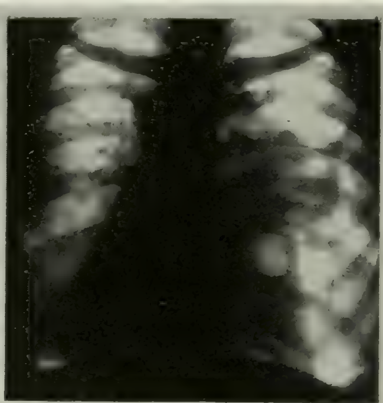


FIG. 5



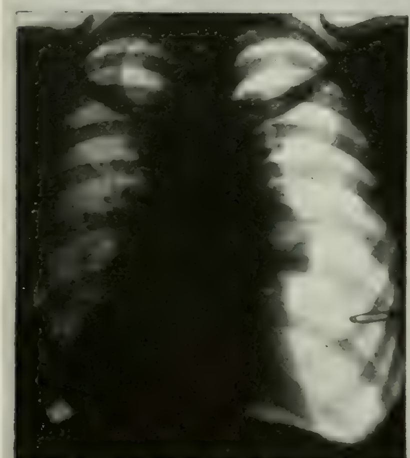


FIG. 6

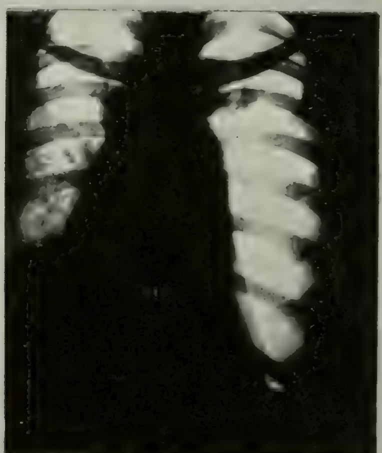


FIG. 7

FIG. 4.—Shows the completely collapsed lung after the cauterization. A small exudate is still at the bottom of the pleural cavity.

FIG. 5.—A common picture of a lateral adhesion, which prevents the lung from collapsing. In the lung are numerous large cavities.

FIG. 6.—Shows the appearance of the lung about fifteen minutes after cauterization. The lung is already considerably compressed.

FIG. 7.—The complete collapse of the lung after a few months continued treatment.

had extensive adhesions in the upper part of the chest, which it was not possible to remove by this method. The aim of the

Fig. 8

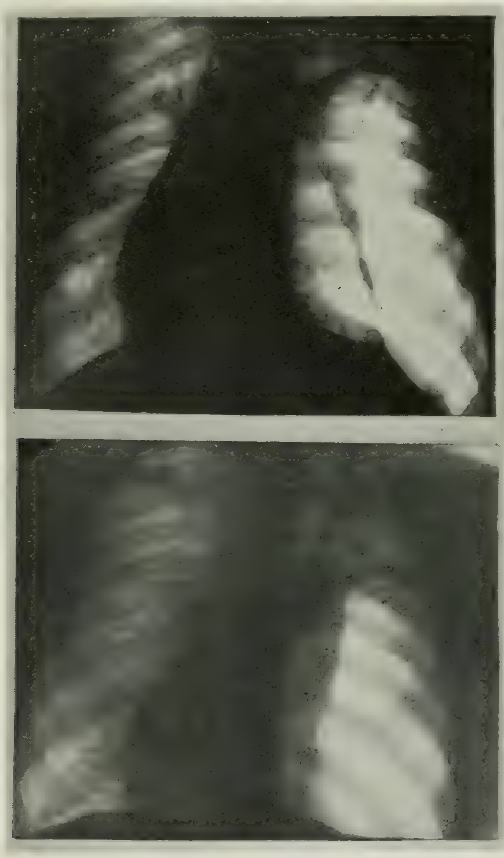


Fig. 9

Fig. 8.—Case with a string-shaped adhesion at the diaphragm and with extensive surface adhesions near apex, which it is not possible to remove. In the lung are several cavities.

Fig. 9.—After cauterization of the diaphragmatic adhesions a better compression of the lower part of the lung is gained.

operation has been, in removing the diaphragm adhesions, to get a better compression of the lung in the upper part of the chest

cavity. This is, in my opinion, only possible in exceptional cases.

The total sum of cases with clinically successful result is thus 35. Among the 11 cases in which only incomplete cauterization was performed the clinical result was good in 1 case. In only 1 of the latter cases did a severe protracted pleurisy occur.

With regard to other authors, Holmboe has in 12 cases had 7 clinically successful results. In 16 cases Gravesen had 9 technically successful results, and of these 7 became bacilli-free. Two of the incompletely cauterized cases took a change for the worse because of empyema and protracted fever. The probable cause seems to have been an attempt to extend the indications for operation by burning off rather extensive adhesions. One can in his report find that cauterizations were made in several seances, each of a duration of from one to two hours. It is evident that the danger of exudate in such cases must be rather great.

Summarizing the results in these 78 cases reported up to the present time, we find that in 55 cases, or in about 75 per cent, we have succeeded by this method technically completely to remove the adhesions which prevented the complete collapse of the lung. Naturally the clinical results are not so favorable, as only 49 cases, or about 63 per cent, have been symptom-free. If we now return to Table I, the practical result would be thus, that in cases of adhesions (Gravesen's groups II and III) one can improve the patients to such a degree that the future prospect of health increases from 33.33 per cent and 11.1 per cent respectively to not less than 70.2 per cent (as in Gravesen's group I). The mortality would, according to the same table, fall from 66.67 per cent and 86.7 per cent respectively to 23.4 per cent. Whether this in reality has been so in the cases hitherto operated on I cannot say, partly because the time which has elapsed after the operation is too short and partly because some patients have been sent to sanatoria and their further progress has not been under our observation. A rapid survey of the facts now available would give less favorable figures, as they indicate a deathrate of between 30 and 40 per cent, which, however, of course,

has nothing to do with the operation itself. Many factors surely enter into play. One reason for the less favorable results appears to have been the fact that the patients were from the poorer classes and therefore unable to get sufficient nursing. The adhesion cases are often more severe than those in which a complete collapse is obtained.

Although we have not succeeded in getting as good health percentage as in cases of simple pneumothorax without adhesions, this method ought to have a permanent value at least in a limited number of pneumothorax cases with string or membranous adhesions.

COMPARATIVE PATHOLOGY OF THE HEART AS SEEN IN THE CAPTIVE ANIMALS AT THE PHILADELPHIA ZOÖLOGICAL GARDEN

By HERBERT FOX, M.D.

The heart is an organ whose duty, throughout the two classes considered in this study, remains entirely identical, purely a physical one in driving the blood through the corresponding vascular system. The physics involved naturally differs between mammals and birds, but energy is derived from the automatic power lodged in the cardiac musculature. Whether this be neuromyogenic, as seems to be the case in all mammals, or purely myogenic, as is probably the case for the birds, in which McKenzie and Robertson[1] say there is no atrioventricular bundle, the result is the same, since in both classes there is some continuity of muscle fibers from auricle to ventricle. The gross anatomy varies little if any more than the physiology, albeit there is proportionately greater auricular capacity in the mammals than in the birds, and indeed there are differences within the classes which cannot now be readily explained; certain minor variations of valvular arrangement exist, such as in the absence of the membranous right tricuspid in Aves. When, however, one considers the cardiac power available for various animals the subject becomes one of greater breadth and complexity, for no consistency obtains even within families, since the demand for vascular strength will vary more with habits than with zoölogical relationships. Thus, for example, the domestic rabbit has a small heart volume

[1] Read December 7, 1921.

while the wild hare has a great one. While, of course, the size of an organ may not be an absolute measure of its efficiency (a flea's leg muscle has relatively greater power than a man's), yet it is the only physical gauge one has for estimating Nature's preparation for expected demand. Perhaps this will be shown later when after discussing the pathologic anatomy of the heart in the wild mammals and birds we can study these changes in the light of statistics upon the relative size of the heart.

The diseases of this organ are known by their physical effects, chiefly by causing physical or functional defects in other organs, and to a minor degree by purely physiologic irregularities of the heart itself (tachycardia, arrhythmia, fibrillations). All the latter and most of the former are subjects discovered by observation during life, and unfortunately cannot be included in the study at hand. Both states are well known to the veterinarian, who diagnoses them with reasonable ease in animals that can be handled. I saw one case of arrhythmia in a monkey dependent upon no anatomic change found later at autopsy. Some of these functional abnormalities are certainly caused by myocardial disease, and cardiac failure has occurred among many orders. An interesting observation was made by Plimmer[2] on several large birds (ostriches, storks, cassowaries) which apparently died from this condition; at autopsy he found myocardial degeneration, or epicardial edema, or only a flabby heart. Lack of exercise was held responsible by this observer. Such cardiac deaths have probably been encountered in the Philadelphia Garden, but we have accounted them to shock or gastro-intestinal disease; this matter will be discussed on a later page.

If a degenerative sclerosis of coronary vessels be the cause of angina pectoris, then perhaps paroxysms of this kind occur, for we have seen such anatomic changes in the heart of three widely separated varieties, a Nylghaie, two Old World Monkeys and a Brown Pelican. The history of these animals does not register anything resembling the clinical picture of angina pectoris in man, and they did not come to their death from the arterial changes in the heart alone, since sufficient other pathology existed.

As an introduction to the strict pathology of the heart it might be well to outline the headings of the scheme upon which it seems desirable to study the subject. It is hardly profitable to take up *seriatim* the ordinary general pathologic processes as discussed in systems of pathology, for it is our purpose to show the distribution of basic aberrations from the normal in terms of zoölogical position. To this end one must consider the response of the heart to (*a*) damaging influences and (*b*) an increased demand for work. In the first group come degenerations and inflammations upon which may succeed an incompetency in the form of dilatation. The response of the normal heart to any physical demand greater than customary has usually been thought to lead to hyperplasia, but on occasion it has seemed to be in the form of dilatation, especially if the strain has been sudden and severe. Starling thinks that the primary and normal reaction of the heart to physical strain is always dilatation. The idea of hypertrophy must not be confused with an understanding of the relatively large hearts of animals whose habits demand great cardiac power, for then it is their norm and might be called "physiologic cardiac hyperplasia." I shall use the terms "increased muscle bulk" and "increased chamber space" as preferable to hypertrophy and dilatation; this also focusses attention upon the two features of an enlarged heart.

Degenerative responses to insult are recorded in our system as amyloid, hyaline, fatty metamorphosis, granular and cloudy degeneration. While there is perhaps between some of these conditions and true myocarditis a matter only of degree, the records shall be analyzed as filed and perhaps some lessons can be drawn from the responses of the various orders. In the accompanying table will be found the distribution of degenerative and inflammatory lesions through the zoölogical orders.[1] The percentages speak for themselves, but deserve as well some consideration from the standpoint of normal heart value; this will be taken up later after the other lesions have been discussed.

[1] Analytic charts not reproduced; table given is consolidated from individual tables.

There are very few points within this general group which seem worthy of separate mention, endocarditis and myocarditis being exceptions.

Orders.	Number posted.	Per cent. degenerations, etc.	Per cent. hypertrophy.	Per cent. dilatation.	Normal heart weights per kilo of body weight.[1]
Primates	498	8.0	0.8	0.8	6.56 (4)
Lemures	86				
Carnivora	481	11.0	2.1	2.2	6.78 (6)
Pinnipedia	20	50.0			
Insectivora	4				
Chiroptera	5				
Rodentia	199	8.0	....	4.2	5.5 (5)
Ungulata	365	5.6	1.2	3.0	5.8 (10)
Proboscidea	3	33.0			
Hyraces	7				
Edentata	16	44.0	....	12.5	
Marsupialia	176	19.0	0.6	5.0	5.1 (3)
					Av., 5.8
Passeres	1355	1.4	....	....	19.8 (43)
Picariæ	87	6.7	1.4	....	21.3 (9)
Striges	133	0.8	....	....	7.33 (4)
Psittaci	689	3.6	....	0.1	8.89 (6)
Accipitres	196	18.7	4.3	0.5	12.32 (7)
Columbæ	157	2.0	....	....	14.47 (4)
Galli	299	10.0	0.7	0.7	11.08 (16)
Fulicariæ	35	9.0	....	....	23.82 (3)
Alectorides	37	6.0			
Limicolæ	6	....	....	....	8.7 (2)
Gaviæ	20	10.0			
Impennes	6	16.0			
Steganopodes	20	21.0			
Herodiones	98	4.3			
Anseres	317	11.7	0.6	1.5	11.8 (14)
Struthiones	32	35.0	6.6	....	12.7 (1)
					Av., 13.8
All other orders	18				
Total mammals	1860				
Total birds	3505				
Total	5365				

Romberg said in his classical work on the heart that there is always some form of myocardial disease with endocarditis, and general experience seems to corroborate this. The 44 cases detected at the Philadelphia Garden are 15 of chronic nature

[1] Man, 5.67 (4).

and 29 of acute or subacute character. In the former, the chronic, 9 showed some grade of muscular involvement while 21 of the 29 acute cases of valvular inflammation were accompanied by myocardial damage; the percentages are 64 for chronic and 72 for acute, a relation that would be expected if one would credit the theory that many valvular inflammations start at the root of the valves, but, at all events, indicates that after the acute changes have passed the myocardial damage may be improved. The large number of endocarditides among the Carnivora, Accipitres, Anseres and Marsupialia is noteworthy and can hardly be explained by other argument than a special vulnerability of this organ. However, an unusual number of cases in our only native marsupial, the opossum, seems worthy of a special note, since 10 of the 12 instances in the order affected this particular animal. When seen these 10 cases were acute in 5 instances, subacute in 3 and chronic in 2. The Streptococcus pyogenes was isolated in 3 of the 5 acute cases; bacteriology of the others was negative or not done. All of the acute and one of the subacute cases were combined with some evidence of general septicemia. The type of lesions was in no way peculiar, unless the fact that all were vegetative when acute and markedly deforming when chronic be notable. In 2 chronic aortic cases the valvular orifice was almost closed, yet the left ventricle could not be considered as greatly hypertrophied and no dilatation existed. In one acute aortic and mitral case general dilatation existed. The mitral was involved 9 times, 3 times alone, 4 times with the aortic, once each with the tricuspid and pulmonary. Once the vegetations were limited to the mural endocardium. Nine of these animals came from one enclosure over a period of two and a half years, during which time other opossums died from similar infections, despite repeated cleansing of the place. No unusual number of cases of this or similar kinds occurred elsewhere in the Philadelphia Garden at this time, but it would seem that we had in this cage a continued infection expressing itself chiefly as endocarditis.

The response of the heart to a continued demand upon its

working capacity will, as already indicated, lead to increased muscle bulk or to larger chamber size. Whether hypertrophy be purely the building of a bigger engine or be accompanied by or due to muscular disease, as had been suggested by certain authors, was a question to which an answer was hoped, but it would seem that the solution is no nearer than can be obtained in human pathology. Fifteen of the 34 cases showed some degree of myocardial damage.

The so-called essential hypertrophies have been recognized not only by human pathologists, but more especially by veterinarians, but this group is indeed vague even if, along with Rievel and with Aubertin[3] we assume that some low-grade intoxication exists and makes the heart work harder. For information concerning this and pathologic enlargements one may consult the chart of hypertrophies and dilatations, but in advance the method of charting must be known. Since it is usually impossible to decide what may be the single important factor in the cardiac disease, all of the accredited factors have been listed with the hope that the resulting figures would be significant. Thus an animal may have recorded a pericarditis, a nephritis and an arteriosclerosis—who shall say which was primary or most potent in the cardiac change? Essential hypertrophy shall be limited to those cases for which there was no concomitant pathology which might have been responsible for the overgrowth. There was one in a carnivora and one in a raptatory bird.

Idiopathic dilatations, on the other hand, are much more common, but they still bear a relation to the apparent vulnerability of the heart. Their distribution is as follows: Primates 1, Carnivora 1, Pinnipedia 1, Ungulata 1, Marsupialia 4, Anseres 1. These may be cases such as Plimmer described, of cardiac failure, indicated by dilatation the result of inactivity. Besides these special instances and the ones accounted for in the list there were three acute dilatations apparently due to shock, two ungulates and one marsupial, probably incidental to fright when being caught by the keepers.

The association of secondary dilatation with hypertrophy

is only evident in three instances. One case, and perhaps the most interesting, is that in which the principal antecedent pathology was thyroid hyperplasia and nephritis; the dilatation was perhaps agonal or shortly before the last struggles. It would seem that all of the dilatations occurred shortly before death, because long-standing, passive congestions and dropsies of cardiac origin are exceedingly rare; only one certain case is recorded (Carnivora).

Let us now examine the chart according to orders and then as to causation. The Primate's heart is apparently well able to increase in size in response to increased work, a demand most often made by pulmonary, pleural and pericardial diseases. Two of these cases occurred in animals suffering with pulmonary tuberculosis sufficiently extensive to impede cardiac action, while in another case the tuberculous lesion was mild but a pericarditis existed. When the right-hand columns are inspected it would seem that on occasion dilatation may occur; one of the tuberculous pulmonary cases had a dilated heart. The slothful Lemures apparently have no call upon their cardiac mechanism. Carnivora have a large organ, which, it would seem, should be prepared for excess work either simply as a reserve or as an inherent ability to grow; it presents in about equal numbers hypertrophy and dilatation. It is admitted that there are within this order genera of differing habits, but analysis of the Canidæ, Felidæ and Ursidæ, for examples, in the first place offer too few specimens for conclusions, and, secondly, have upon trial actually shown nothing definite, so that we are forced to use the larger group, the order. It is interesting to note that long-continued infection is in this order the most potent factor to enlarge the heart. Four of the 10 cases show myocarditis, a fact which rather strengthens the argument in the last statement. Nephritis does not seem so very potent in hypertrophy, but occurs in high figures in instances of dilatation. Three of the cases were associated with thyroid disease and two of these showed dilatation as well. The general causes of dilatation are more diverse, and we see associations that do not appear as under

hypertrophy, namely, arteriosclerosis and diseases of the chest. The rodents seem to have no power to increase muscle, but a sufficient number of cases of dilatation occur to make one conclude that this is their method of response to unusual strain. Pulmonary disease, mostly of infectious nature, and myocardial degenerations are the principal causes. This seems a very striking invalidism of the order and is the more notable in the light of the fact that Dr. Donaldson has found that rats made to exercise live a shorter time than those allowed to remain in quietude. The next order to show cardiac enlargement is the Ungulata, where nephritis is most frequently associated with hypertrophy and disease of the pleura and pericardium with dilatation, or the reverse of the factor value in Carnivora. These animals, fairly well prepared for flight, with moderately large hearts, seem more often to show dilatation than hypertrophy. Two Edentata (armadillo) showed dilatation but no hypertrophy. Marsupials behave somewhat like rodents in that the heart does not seem to increase muscle bulk, but our records do not explain this clearly. As already mentioned, 4 cases had no sufficient internal reason for dilatation, but as one was probably the result of shock, 3 only remain to be accounted for. Nephritis seemed to exist in all 3, but 2 of them had Kangaroo mycosis of the jaw and a general chronic infection.

If our attention be given to the Aves we find the highly specialized Passerers and Striges not represented and their closely related well-organized orders Picariæ and Psittaci with only an isolated single case. This is the more interesting since the last order suffers reasonably often with arteriosclerosis. Accipitres, the birds of pugnacious habit and carnivorous diet, seem well able to increase their muscle upon demand, but do not often suffer dilatation. Vascular and renal diseases stand out most prominently in the etiology and one-half of them show myocardial change. The Galli, which includes both ground and flying birds, are represented but fail to exhibit any unusual accompanying disease. Anserine birds apparently have a low power to increase the size of the heart, but most often allow it to dilate.

Struthiones, large stalking and rapidly traveling birds, apparently have a good margin of safety in their cardiac mechanism.

If now the associated pathology be studied it will be found that among the mammals, renal disease, chronic infections and diseases of the thoracic serosæ are most often responsible for hypertrophy and that something over one-third of the hearts showed myocardial damage. Among the Aves arteriosclerosis and renal disease are most important in enlarging the heart; half of the cases had myocarditis. In so far as dilatation in mammals is concerned, renal disease and acute infections are decidedly more important than the others, even than the next in order, chronic infections and pulmonary diseases; only one-fifth of the cases had myocardial disease. Acute infectious disease is the most potent cause of dilatation in birds; only 2 of the 8 cases had degeneration of the heart muscle.

If now the incidence of increased muscle bulk in the two classes be examined it will be found to occur two and one-half times more often in mammals while dilatation occurs nearly ten times as often among the mammals than among the birds.

Hypertrophy is accompanied by myocardial change in 44 per cent of the cases while muscular degeneration was only seen in 24 per cent of the dilatations; this change is conspicuously lacking in the Primates, Ungulates and Marsupials. The usual teaching has been that dilatation, which means enlargement of chambers and thinning of walls, or at least no thickening thereof, implies an inability on the part of the heart to keep up with increased demand—a decompensation. If Starling be correct that dilatation is not a degeneration of pump value but merely one of adaptations to increased demand, then this method is more characteristic of mammals than of birds. There is, however, the reserve power to increase the muscle bulk inherent in the mammalian not possessed or needed by the avian heart. The overhearted class Aves certainly dilates its blood pump less frequently than mammals and indeed has less cardiac disease. An analysis of the incidence of hypertrophy versus dilatation shows that hypertrophying power resides in the Carnivora,

Accipitres and Struthiones, their hearts relatively seldom dilating. Lack of such power and consequent dilatation resides in Rodentia, Ungulata, Marsupialia and Anseres. Hypertrophying power lies therefore chiefly in the heart of average size for its class, dilatation occurring in the small heart.

There is to be little learned from the nature and anatomy of the hypertrophies and dilatations except perhaps the character among the birds in which the physics of the circulation is somewhat peculiar. In this class both the hypertrophy and distention are predominatingly left-sided, a state probably explained by the pressure against which the pump must work in flight, because then the lungs and the viscera are somewhat compressed by the pressure of an excess of air in the pneumatic sacs. At all events while concentric hypertrophy was mentioned once, it is difficult to estimate the degree of increase in the right chambers because they are not uncommonly well filled when diastole occurs at death. Grober[4] asserts that the normally large heart (or what I have called "physiologic hyperplasia") shows "hypertrophy" of the right ventricle because of the extra work entailed in flying. This is certainly not the case in the material we have seen under pathologic conditions. Right-sided increase might be expected if pulmonary or serous membrane affections were prominent, but left-sided increase, following arteriosclerosis and nephritis, is the actual finding. The best examples of concentric hypertrophy are in the dogs with thyroid disease and the best examples of concentric dilatation in Ungulates suffering shock.

The foregoing pathologic data can now be summarized by grouping the facts under the headings of absolute and relative vulnerability of the heart. By the former is meant the actual number and quality of lesions in the various orders, but here at once one comes upon the irregularity of examples of zoölogical and pathologic character, and if one trust entirely to the percentages, fallacious conclusions might be reached. Basing judgment upon the incidence of pathologic lesions in mammals and birds, it is evident that the former has greater vulnerability—as 13 is to 6.2. This is noteworthy, as we shall learn that

the bird has a larger and apparently better prepared heart than the mammals. Attempts to discover the order or kind of animal having the greatest or lowest vulnerability are difficult for the reason given above. Thus, for instance, Pinnipedia, Proboscidea, Edentata, Gaviæ, Impennes, Steganopodes and Struthiones present the highest percentages of cardiac lesions, but the total specimens examined are so few that these figures may well be misleading. If, however, figures mean anything in such small groups, these are the animals which have the greatest vulnerability. They have little in common in regard to zoölogical relationships and habits; four of the seven orders are rather slothful and three are active. It is much better to limit our observations to those orders from which sufficient examples have been subjected to autopsy and upon which we have some standards for comparison in the heart body weight ratio. It so happens that in the above seven orders I was unable to obtain any reliable figures. The table is a combination of data for the principal orders from which we have enough material (at least one hundred autopsies) and for which it is possible to obtain figures indicating the weight of the heart in kilograms of body weight. The information was obtained from some of our figures and the references given in the literary references. There are no extensive data upon weights and measures in exact terms, such as body weight, so that we are limited to the numbers quoted besides the orders in the table. The ratios might be modified slightly by greater observation, but they show certain things by comparison of the classes, and in a rough manner the heart ratio corresponds to the pathology. However, there are many reasons why great caution should be used in evaluating the relative size of the heart. Welcher showed in his work that the proportion is greater in small and young animals than in large and adult ones. All the authors quoted agree that in birds, and to less degree but still clearly in mammals, there is a direct relationship between the bodily activity of an animal and its cardiac bulk. This is fairly well shown in the list of avian heart ratios, but not so clearly in the mammals. What should be considered the most active mammals? The monkey

perhaps, with his tendency to be occupied constantly; yet we find the greatest heart bulk among the Carnivora, animals prepared for travel and struggle, and the smallest among the Rodentia, quiet and timid animals. The avian order showing the great cardiac ratio, the Fulicariæ, shore birds, is made up of some quiet hiding varieties and of some capable of ascending to very high elevations, but the active fliers also have high weight proportions (Passeres). The inactive owls have the smallest heart bulk.

The contrast between the average heart to body weights of mammals and birds is striking, the latter having two and one-half times as much as the former. Since this is the most prominent and best supported statement in the table of weights, it may be used to compare with the incidence of the pathology as seen in the two classes.

Degenerations occur in mammals and birds as 9.5 to 5.5.

Hypertrophies occur in mammals and birds as 10.3 is to 4.3.

Dilatations occur in mammals and birds as 2.4 is to 0.28.

In other words, the mammals are much more susceptible than birds to degenerative and inflammatory processes, show an ability to increase the muscle bulk two and a half times as great and are liable to chamber distention nearly ten times as often. It might also be put that birds cannot or do not need to increase their muscle and that the chamber to muscle balance is more perfectly arranged.

While in the preceding pages hypertrophy has been discussed rather from the standpoint of its value as a compensating and reserve capacity, and dilatation as a degenerative or decompensatory process on the part of the cardiac mechanism, it may be that dilatation of the mammalian heart is the usual method employed by the class in response to increased demand. It seems highly probable, however, that the originally and normally larger heart does not increase its chamber space and does not need an increase of its muscle to overcome strain. Hypertrophy was accompanied by myocardial disease in 44 per cent of the cases while dilatation showed this change in only 24 per cent.

If this thought be carried into the various orders of the classes

the results are not by any means as clear. However, the large heart of the carnivores increases both its muscle and chambers while the small hearts of the rodents and marsupials more often dilate. Analysis of the avian orders is not conclusive and somewhat contradictory. Let it suffice to say that the birds which fly most, with the exception of ducks, have a relatively low vulnerability, and the soaring carnivorous Accipitres and the largest birds, Struthiones, apparently have a high susceptibility to damaging influences and enlarge their muscle bulk in response to increased work.

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DISCUSSION

Dr. Edward Bell Krumbhaar: I take it that one major interest in Dr. Fox's paper to this audience would be in its application to human pathology of the heart. When I was asked to discuss it, as I realized that I could add very little of interest directly, I thought I might contribute a few observations on what is really a closely related topic, namely, that of experimental comparative pathology.

I want to emphasize first of all that in considering experimental pathology one should always be very careful in interpreting the results obtained from experiment. One example which comes to my mind is in the argument that took place some years ago when the myogenic and the neurogenic theories of the heart-beat were under discussion. At

that time Dr. Carlson produced a very striking experiment with the horseshoe crab in support of the neurogenic theory. The heart of this animal is a very simple affair, nothing more than a dilated tube with three nerves running down its length. He found that by sectioning any one of these nerves paralysis or heart-block of that part of the heart would result. If the central nerve were cut, immediately the heart from there down stopped beating; if the side nerve were cut, the segment of the heart from there down stopped beating. A very clear example of how the heart-beat in this animal is controlled by the nerve, and that, I think, is accepted today. But this experiment has proved to be of no practical benefit to the study of the heart-beat in mammals or man; in fact, the only effect it had was to delay the acceptance of the myogenic theory. I mention that as an example of how the results of some experiments must be interpreted with great caution, and it seems that the further distance the animal is from man the more caution should be used in applying the results to man. On the other hand the great majority of experiments on mammals, as experience has shown, have furnished evidence of value to clinical medicine. I think one need only mention the valuable studies on the experimental production of myocarditis by adrenalin and spartein by Dr. Pearce and others, or by chemical or bacterial toxins, or those in experimental endocarditis by mechanical or bacterial damage, or those in experimental pericarditis by injection of turpentine and other irritants. The more recent domain of disordered mechanism of heart-beat owes still more to experimental pathology. Not only can every form of cardiac arrhythmia be produced experimentally, but the study of the experimental lesions has in many cases formed the chief basis of advance in our knowledge of these conditions. Even very recently the true nature of auricular fibrillation and flutter was demonstrated by Mines, Garrey and Sir Thomas Lewis, first on animals and afterward applied clinically to man. So that I think if we keep constantly in mind the one point of the need for the careful interpretation of results, we shall profit greatly by the study of experimental comparative pathology.

Dr. Richard H. Harte: I think we owe a great debt to Dr. Fox and the Zoölogical Society for the very good scientific work that is being done at the Gardens, fostered and supported by Dr. Penrose. Dr. Penrose, since he assumed the management of the Zoo, has been very active in looking after its scientific work and has never lost an opportunity to utilize the material at the laboratory's disposal. If one will compare the zoos in this country, while the Bronx is larger, I think there is more good scientific work being done in the Philadelphia Zoo than in any other almost anywhere in the world. Of course that may be an

extravagant statement. The work is not spectacular upon the part of Dr. Fox. He is keenly interested in the pathological side, and he is gradually collecting a vast amount of valuable material. If it had not been for the close observation made there in reference to all animals that die Dr. Fox would not have been able to present this very valuable paper tonight. Each month a report is sent out from the Zoölogical Garden giving a list of the animals that die during that period. Of course, in so large a collection the mortality is naturally very high, and high also because the animals are taken out of their natural environment and their expectancy of life is not as great as it would be in the natural state. But in this list that is sent out careful postmortem examination is made of each specimen, and when an animal dies we know what the cause of death is. One of the marked features in the work carried on there is the inoculating and testing of monkeys for tuberculosis, which has practically stamped out among these animals this disease, which everybody knows is one of the banes of all our zoölogical gardens. Our monkeys out there are kept in the open and in well-ventilated cages. The practice is, when a monkey is purchased he is quarantined for a certain length of time and thereafter thoroughly tested, and when found free from tuberculosis is admitted to the general family of monkeys. I think we owe a great debt of gratitude to Dr. Penrose and to Dr. Fox and his confrères for the exceedingly good work being done at the Zoo.

Dr. Judson Daland: I was deeply interested in Dr. Fox's paper, which is unique. His suggestions as to the possibility of animals suffering from angina pectoris based upon the occurrence of coronary sclerosis is an interesting speculation. We now know that many cases of coronary sclerosis occur without angina pectoris. I should like to ask if the myocardium showed degenerative changes that might be due to atrophy secondary to insufficient blood supply in consequence of coronary artery disease? I should also like to ask as to the existence of infection in animals when myocarditis or endocarditis is present, and if so what form of infection is usually present?

Dr. James M. Anders: Just one phase of the general subject so ably presented by Dr. Fox I should like to refer to most briefly. When the human heart is about to hypertrophy there always occurs a primary dilatation. That dilatation is quickly overcome by the hypertrophy, at least in great measure, which in the human heart is due to multiplication of the muscle fibers rather than mere increase in size of existing fibers. Now since hypertrophy is more common in mammalia than in the lower classes of animal life the former must possess the power of

multiplying muscle fibers when subjected to continuous overstrain while the hearts of the latter are without this reserve power, hence merely go on dilating.

Dr. Herbert Fox: In reference to Dr. Krumbhaar's suggestion of the caution with which comparative observations should be received and proof drawn therefrom, I must say I quite agree with him, and I think I tried to draw my conclusions and make my statements with reserve. The whole course of the work has seemed to be logical and the results were so clearly cut that I ventured to put them in the form I did. It would seem to me that the study of the reactions of a large number of animals comparatively like these, even though they are under captive conditions and therefore outside their natural home habitat (and may be the human being is also) is safer—if experience teaches that it is dependable—than the introduction of needles through hearts or a cutting of vagi or any experimental procedure. That is my opinion, but I may be wrong. In reference to Dr. Daland's question in regard to the incidence of myocarditis in the four animals I mentioned, I have not them in my notes, but I am sure both of the monkeys had a definite myocarditis. The antelope and pelican I cannot quote. I can find it out and let Dr. Daland know. I did not quite understand the other question as to the percentage incidence in the animals affected with myocarditis. The incidence of infection with myocarditis, continued or acute, with endocarditis is about 70 per cent of the cases. In reply to Dr. Anders, perhaps I did not make my statement clear, but I feel probably that is the case in the mammals; but it would seem as if the mammalian heart possesses, even though it does dilate more often than the avian, a power in reserve to increase muscle bulk possibly to overcome dilatation; but at least there is a margin of safety in the mammalian heart which the bird either does not have or does not need.

PRESENTATION OF MEMENTO OF LORD LISTER FOR THE CUSTODIANSHIP CASE

Dr. Robert Abbe: The second memento which I was able to secure of Lord Lister's is one which will increase in value and heighten in interest as time goes on, if it should be fortunate enough to stay here for a century, and would be even more difficult to produce at that time than in the present. The wonderful name of Lister will probably never be less distinguished in our profession than it is in our lifetime, and anything that is personal to him, like the knives in the cabinet or this little set of tubes, will always have a charm and serve a purpose, because while Lord Lister was no greater than other men, it came to his fortune to initiate a phase of surgery which, as we all know, was the beginning of a new line of work. Of course, vast numbers of men did as much and worked in the same spirit as he did, but they are never heard from. They are like the unknown soldier who, in the beautiful words of our President, "His name took flight with his imperishable soul," but there are some imperishable souls whose names have not taken flight. We all cherish a few of these and they cheer our lives, whether young or old, whether students or in the working ranks of our profession. We have five names associated with the College Custodianship Cabinet, and only one was a surgeon. The others have great distinction, such as Pasteur's, but they all have a place in the life of our world.

The whole world was stirred in 1865 when Pasteur announced his observation that the bacterial origin of disease was probably the great subject for the future study, and, as he told the Emperor Napoleon III, it was his ambition to show that bacterial origin was the cause of all putrid and contagious diseases. He did not live to do that, but he initiated it. Then Lister took it up from the surgical point of view, saw its importance and immediately worked industriously to study bacterial infection in surgery. In his untiring effort to explore that field and initiate methods in modifying surgery, he tried a vast number of experiments allied to but different from Pasteur's. He chose putrescible milk for study, and he devised a lot of little tubes, of which these are some—little tubes made like small test-tubes capped by glass thimbles and fitted in an ordinary rack of glass tubing wired together with silver wire to hold them up. These he filled with putrescible milk, as nearly fresh milk as he could get. He labored weeks and weeks to get milk not con-

[1] Read December 7, 1921.

taminated. He believed that he must get milk without dust which caused the lactic-acid ferment, especially dust from the dairy and the farmyard, and at last he secured perfectly pure milk—going out in wet weather, cleansing the teats of the cows, milking out in the wet grass where there was no dust, and thus getting milk that would not ferment, that he transferred to these tubes and some of them he inoculated, some of them he did not, and he found that for months that milk was just as sweet because no dust had gotten into it. He used these identical tubes in his lectures because they told the whole story. This set of tubes is on a square of plate glass, as you will see, the identical piece he used. He put the plate and tubes in a little sterilizer of his own device and brought it up to between 200° and 300°. When it was cooled he put into the tubes the milk, of which the dried remnants are still there as he looked upon them. He found, also, when he dipped the finest point of a needle into putrescent milk and introduced it into a tube that the milk would go bad. When milk was in and the glass cover put on, dust could not get in: that was whole proof. These tubes were identified and have on them labels with numbers he put on them, so they become doubly interesting.

Sir Rickman Godlee wrote the *Life of Lister*, and in that this woodcut which I show you, of this identical set of tubes, will be found. I cut that out so we can place it in the volume devoted to Lord Lister in our Cabinet.

I have also a card of Sir Rickman Godlee's (a nephew of Lord Lister), stating that these are the identical tubes which Lister used in demonstrating lactic-acid fermentation of milk when contaminated with dust, or putrefaction, or uncontaminated. These tubes have been preserved very carefully by Sir Rickman Godlee, who has now retired from practice. He showed them to me when I chose at first the knives. He said, "These are something I would rather part with." I chose the knives, because they typified the surgeon, Lister, but afterward I regretted not accepting his view, that the experimental tubes marked the initiation of a new era in surgery. After some correspondence and solicitation I have brought these to the Cabinet as a treasure trove most graciously given by Mr. Godlee. Here we have something personal; here we have the essence and spirit of Listerian principles demonstrated in his earliest work.

Dr. Francis R. Packard: The College has on a number of occasions been placed under a debt to Mr. Henry Reed Hatfield for handsome gifts, notably in connection with the Hatfield Prize Fund and we might also recall Mr. Hatfield's gift of the beautiful edition of Aristotle which we

have in our Library. A few days ago Mr. Hatfield laid us again in his debt by presenting to us this beautiful little book by Richard Mulcaster. The book is very rare in any edition, especially rare in this, which is the first edition, and in an especially good state of preservation. Mr. Hatfield's attention was called to it, and as it was the first book, in the English language on the subject of the hygiene of schools, he though it would be an appropriate gift to present to our College, and accordingly did so. I might state that there is a rather ill-founded tradition that Richard Mulcaster was the original figure of the schoolmaster in Shakespeare's "Love's Labor Lost." Our late townsman, Dr. Horace Howard Furness, said this was not true, that the pedagogic schoolmaster was no more Richard Mulcaster than he might have been some other character. I move you that a vote of thanks be extended to Mr. Hatfield for his very generous gift of this very valuable book.

APPENDIX.

PROCEEDINGS

OF THE

SECTION ON OPHTHALMOLOGY

JANUARY, 1921, TO DECEMBER, 1921

JANUARY 18

Disk-like Congenital Cataract

Dr. Wm. Zentmayer presented a boy, aged twelve years, who was referred to him by Dr. Seiberling, of Allentown. The vision had been poor since birth. There was no history of trauma or tetany. Patient's grandfather, father, an aunt, an uncle and two paternal cousins had congenital cataracts.

The examination showed cornea clear and A. C. normal. In the R. E. there was an irregular disk-shaped, chalky-white area in the lens surrounded by a grayish zone. Beyond this the margin of the lens was plainly visible as a highly refractile line appearing like a fine silver wire. The zonule could be plainly seen. No details of the fundus could be made out. The L. E. was as R. E., except that the disk-shaped opacity was smaller. According to Collins and Mayon in disk-like cataract macroscopically the lens is flattened anteroposteriorally so that there are two lateral masses connected by a band. In the central flattened portions of the lens

a laminated mass of tissue is situated similarly to that met with in anterior polar cataract; it extends from capsule to capsule. In the rounded portion there is lens substance showing a varied amount of disturbance of distribution in the vicinity of the central portion becoming more regular and normal toward the periphery. Failure of development of the nucleus is probably the cause of the cataract. The cells of the posterior layer of the lens vesicle fail to lengthen out into lens fibers. The activity of the cells lining the anterior and lateral portions of the lens capsule is unaffected. The laminated mass in the center is probably produced in the same way as an anterior polar cataract, *i. e.*, by proliferation of the anterior cells, as the outcome of low intracapsular tension in their vicinity. In these lenses where the nucleus fails to develop there would be abnormal low intracapsular pressure in the neighborhood of the anterior pole of the lens, hence the formation of an anterior polar cataract. The activity of the cells lining the sides not being interfered with, lateral lens fibers develop. Having no nucleus around which to group themselves they form accumulations of fibers at the sides of the anteroposterior mass, with irregularities and vacuolations of varying distributions.

Tendon Transplantation for Paralysis of External Rectus Muscles

Dr. Luther C. Peter presented a case of paresis of the external rectus in which he practised tendon transplantation by the O'Connor method. The patient was a woman, aged fifty-two years, who developed a convergent squint in late childhood. The left eye was turned in 30 degrees and could not be rotated temporalward more than to the center. Vision was much reduced by an old choroiditis. By the O'Connor method a conjunctival incision was made about 1 cm. from the cornea, extending from the insertion of the superior to that of the inferior rectus. The superior and inferior tendons were split backward for about 9 mm., the outer halves severed from their attachments to the sclera and a

double arm No. 1 silk suture was introduced in each from within out. The external rectus was split into three strands. The superior and inferior strands were cut vertically about 10 mm. from the attachment and were turned forward and united respectively with the superior and inferior transplants already prepared. The internus was completely tenotomized and the external rectus was advanced by a Lancaster whip-stitch, the middle third of the tendon being included in the tuck.

Recovery was uneventful and the patient now has external rotation of 50 degrees and internal rotation of 40 degrees. Upward and downward movements are full. Inability to converge, although there is good internal rotation, is probably due to the fact that the vertical recti are now stronger in abduction than in adduction and a perfect innervational balance for convergence is not yet established.

With a view to the improving of the technic the author suggests that the external rectus should be advanced and attached to the stump of the tendon. The overlapping tendon should then be split in half, turned up and down toward the recti transplants and attached. In this change the nutrition of the tendon will probably be better preserved and tendon will be attached to tendon with less chance of the stitches cutting through. The external rectus tendon is very short, about 4 mm. in length, and the sections by the O'Connor method must include too much of the muscle, with more or less danger of the stitches cutting through the delicate muscle strands, which are turned forward. Complete or partial tenotomy of the internal rectus must necessarily depend upon the degree of the temporalward rotation.

Report of a Series of Remarkable Cases of Injury to the Eyeball

Dr. Walter L. Pyle presented five cases of ocular injury.

The first patient suffered a penetrating wound of the cornea by a piece of broken glass. The removal was followed by the

complete collapse of the anterior chamber. Under the usual first-aid treatment there was a complete recovery of the vision and within a few months every evidence of the previous corneal wound had disappeared.

While hunting a well-preserved man, aged forty-five years, received full in the face the charge of a shotgun. Numerous small shot were imbedded in the face and eyelids. There resulted a slight entropion of the lower right eyelid. A large vitreous hemorrhage cleared in a few weeks and there was complete recovery of the vision. At present the most troublesome sequel is the necessity of occasional epilation of aberrant cilia from the area of the entropion.

A nervous boy, aged fourteen years, was shot in the eye with an air-rifle, at about two-hundred feet distance. A noticeable feature in this case was the profound shock that followed the injury. When first seen the patient showed a penetrating wound of the left upper eyelid, several contusions of the eyeball and dense hyphemia with blood-streaked vitreous. One year later all the objective symptoms had disappeared and corrected visual acuity had increased to 6/12.

A sturdy boy, aged fourteen years, was shot in the eye with B.B. shot from an air-rifle at short range. There was a marked contusion of the eyeball and eyelid and severe subconjunctival hemorrhages. Among the sequelæ of the injury was a traumatic cataract, which under local treatment, including the application of powdered dionin, cleared in two small apertures through which the application of a strong convex lens + S. 10.00 D. afforded vision of 6/12.

While grinding a tool, a machinist, aged twenty-eight years, was struck in the right eye with a fragment from an emery wheel. The injury was followed by a traumatic cataract, gradually reducing the vision to light perception only.

Under full mydriasis a small V-shaped foreign body could be seen, apparently attached to or near to the lower central margin of the iris. The interesting feature of this case was the negative *x*-ray report. It stated that there was no foreign body in the eye,

but inasmuch as it could be seen both by direct and oblique illumination another study was requested. A second report stated that the foreign body was so small that in doing the Sweet localization they were not able to see the shadow in the lateral angle plate to determine the position of the foreign body to the right or left of the median line, but were able to determine definitely that it was in the anterior chamber beneath the cornea.

Dr. Shumway said in connection with Dr. Pyle's second case that he had recently seen a patient who had been struck in the face and chest by a load of bird-shot. One shot had penetrated the lower lid and lodged beneath the conjunctiva of the eyeball, causing contusion of the globe and a localized vitreous hemorrhage, but the eye showed no perforating foreign body.

Dr. William M. Sweet said the failure of the *x*-rays to locate a piece of emery in the anterior chamber was not to the discredit of the apparatus or the operator, even though the particle could be plainly seen by study of the eye. Emery, like other similar mineral substances, offers only a moderate resistance to the passage of the rays and therefore there is not seen on the plate the same dense shadow that is made by steel. Even small metallic foreign bodies in the anterior portion of the globe are often difficult to locate, owing to the shadow of the body being lost in the shadow of the dense bone of the external orbital margin.

Concretions in the Lacrimal Canaliculus

Dr. Edward A Shumway reported two cases of concretions in the lacrimal canaliculus, both in women, one in the lower and one in the upper lid. Epiphora with purulent discharge had existed in each case for a number of months, causing catarrh of the conjunctiva, which disappeared at once on removal of the concretion and curetting of the canaliculus. In one patient the infection had burrowed beneath the conjunctiva, producing a cavity which had a posterior fistulous opening 5 mm. back of the punctum on the conjunctival surface of the lower lid. In this case cultures showed

the presence of a long thread-like organism, so that it was supposed that a streptothrix was present. Further examination showed the organism to be a bacillus in chains, with spore formation, which was contaminated by two other bacilli. Animal inoculation on the conjunctiva was not successful. Dr. Shumway discussed the pathology of lacrimal concretions and said that the concensus of opinion showed that usually the organism found was a streptothrix and that in a number of cases actinomyces was found, which was classed by most observers as a streptothrix; in one case a leptothrix had apparently been proved. Dr. Shumway called attention to the appearance of one of the illustrations accompanying the report of a case of Dalens, which showed long threads made up of bacilli in chains exactly like the organism found in the present case. This would apparently exclude it from the streptothrix class.

Ring Opacity of the Vitreous

Dr. L. Waller Deichler, reported the following case: Mrs. M. H. presented herself for examination January 5, 1921, because of poor sight in the right eye. She had had the usual diseases of childhood: "spinal rheumatism" six years ago, ill eighteen months; exacerbations at irregular periods since, but none as severe as primary attack; fell from a bench at eighteen years and injured the left side, but no head injury or eye symptoms noted. About five years ago accidentally discovered she could not see well with the right eye. The condition has persisted ever since, without change, but she has never had any treatment.

Vision: O. D. — 15/200; O. S. — 15/10???. External appearance negative, cornea clear; anterior chamber normal in both eyes. Pupils are equal and respond promptly to light and accommodation. O. D.: Vitreous haze permitting but limited view of fundus. Tension normal. O. S.: Media clear; disk well defined and oval at 90 degrees; fundus normal; tension normal.

Both pupils were evenly and fully dilated with homatropin. O. D.: Faint haze of vitreous, permitting, however, a good view

of the fundus. Large ring-shaped opacity, oval and slightly flattened above, situated in about two-thirds the depth of the vitreous chamber, in front of and somewhat to the nasal side of the disk, about the size and shape of a cross-section of the lens, everywhere free except for a fine convoluted strand connecting its temporal edge and acting as a guy-rope, so that while this opacity floats around it is kept in the same relative position. View through this ring is unobstructed, as is view around it. Disk is well defined, oval at 105 degrees. Fundus is everywhere negative except for a small, irregularly oval area just below and to the temporal side of the macula lutea. This has well-defined margins and consists of choroidal and retinal change with atrophic change and pigment collection. O. S.: Negative. Field for O. D. gives an absolute scotoma corresponding with the area of fundus change.

Dr. Zentmayer said that he had the records of four cases of annular opacities in the vitreous. They were all similar to the one presented by Dr. Deichler and occurred in the course of a uveitis. They were situated in the anterior part of the vitreous and had a diameter of about that of the orbicularis ciliaris. A possible explanation is that they represent a cast of the ciliary processes.

Dr. Burton Chance stated that he does not believe such ring-shaped opacities as are present in Dr. Deichler's case are unique, although they are not common. He recalls two cases in his private practice, each of which was accompanied by more or less general uveitis. In the one there was a definite history of traumatism and cataract developed a number of years after, and the other was that of a woman who had a low-grade chronic inflammation.

Pseudo Foreign Body of Globe

Dr. H. G. Goldberg reported a case of exudative choroiditis resembling an intra-ocular foreign body, and presented the patient.

The man had been struck in the eye by a fragment of steel, which had been removed, leaving after it a small wound which suggested the possibility of the entrance of another F. B. He had

been seen by several others all of whom concurred in the belief that the pigmented area in the fundus was a foreign substance. The patient was operated upon, unsuccessfully of course, and it was not until after this result that a correct diagnosis was made. Following the operation he recovered normal vision.

FEBRUARY 17

Double Coloboma (Nasal and Temporal) of the Optic Nerve

Dr. B. Alexander Randall reported the history of a young woman whose left eye, hyperopic with practically normal vision, has shown no change in the twelve years she has been under observation. Instead of a vertically oval disk, as on the right, she presents a large horizontally oval disk with deep central porus and absorbing crescents of the choroid at both lateral margins. Within these, defined by no "scleroid ring," each disk margin shows a dark "bottomless" depression, sharp cut outward, the one to the nasal side having the upper nasal vessels passing under its margin, somewhat as the other upper vessels are related to the steep edge of the porus. There is no trace of a colobomatous gap in the choroid or iris. Vision and refraction are equal in the two eyes.

It is a matter of curious rather than germane interest that the grandmother presented to the nasal side of her left eye a horizontally oval lesion of the choroid that might readily have been mistaken for coloboma. I had seen this, however, in its first stage as a patch of choroiditis, in the center of which a bleb of retina was detached by exudate which ruptured into the vitreous and was absorbed, the vague yellow patch of inflamed choroid then going on to atrophy, with pigment heaping at its margins. The first stage of this condition is beautifully shown in Jaeger's plate, but so far as I know there is no recorded observation of

the later stage such as I had the chance to observe through a series of years and in the accompanying sketches to depict. Other members of the family are devoid of notable anomalies, congenital or acquired, so far as examined, although usually about 2 D. hypermetropic.

Capsulomuscular Advancement Without Incision

Dr. S. Lewis Ziegler exhibited a second case of his simplified operation to supplement the one shown before the Section about a year ago.

Miss A. W., aged twenty years, was first seen in April, 1920. O. S. was injured in childhood by a cut of the cornea and iris with probable bruising of the lens. Now has adherent leukoma with slight opacity of the lens capsule. Marked convergent strabismus, O. S. turning in about 65 degrees. Excursion limited to median line. Slight hypertropia. Vision O. S., 1/200; O.D. 20/20. Wearing high correcting glasses.

In May, 1920, a capsulomuscular advancement of the external rectus of left eye was performed by suture alone, without incision, which brought the eye almost into position. This was accomplished by grasping the muscle through the conjunctiva, about 12 mm. back from the cornea, and entering a double-armed suture by a whip-stitch, first through one margin of the muscle and then through the other. The needles were then carried forward over the conjunctiva in a line parallel with each muscle margin and inserted in the sclera at the junction deeply enough to secure a firm scleral anchorage. The suture was tied in a double surgical loop and the tissues drawn forcibly forward until the necessary reposition was secured, when the second loop of the knot was tied.

This advancement was supplemented by an exploratory incision over the internal rectus of the same eye through which the tenotomy hook was passed and the muscle stretched above and below. In doing this a small adhesion of the capsule above was found

and incised, which relieved the hypertropia and brought the eye back to normal level. A partial tenotomy of this muscle was also performed which increased the freedom of excursion.

A Liebreich patch was worn for a few days. A slight crumpling of the muscle was evident for one week. There was no inflammatory reaction but redness persisted for one month. The single external suture was easily removed on the twelfth day. Under cycloplegia the following error was found and prescribed for:

O.D., 20/200. Sph. + 3.50. D. ⊂ cyl. + 62. D.; axis, 105° = 20/15 pt.

O.S., 1/200. Sph. + 1.75. D. ⊂ cyl. + 37. D.; axis, 90° = 20/100.

Examination now reveals excellent parallel movement of the eyes in all directions with complete restoration of excursion to the left side. The eyes are perfectly straight, although a slight tendency to overconverge is sometimes noticed when glasses are omitted.

The result shows that three difficulties have been overcome:

1. Overconvergence from suppressed image O. S., relieved by capsulomuscular advancement of external rectus.

2. Old contraction of capsule and internal rectus from disuse relieved by stretching and partial tenotomy.

3. Hypertropia from adhesion of capsule at upper margin of internal rectus O. S., relieved by division of the adhesion.

Dr. H. F. Hansell said that Dr. Ziegler's patient demonstrates the value of the operation. Its simplicity makes a strong appeal for its performance in preference to those in which the conjunctiva is incised, the capsule of Ténon opened and the tendon separated at its detachment or muscular tissue excised. In this patient and in that Dr. Ziegler previously exhibited to the Section the advancement or shortening was combined with tenotomy of the internus. I judge he would follow the usual custom in concomitant strabismus, in those cases in which the refraction and vision were practically the same in the two eyes, of operating on the externi only. I suggest that equally good or better traction on the sutures could be obtained with the scleral anchorage made

by almost horizontally inserted needles rather than by their vertical insertion. I am persuaded by the excellent results in these two cases to substitute this method for that I have been following for many years.

Dr. Zentmayer said that in this case as well as the one previously shown by Dr. Ziegler the capsulomuscular advancement had been combined with a tenotomy of the antagonist. Almost any advancement operation, if combined with a tenotomy of the antagonist, will give a good primary result. Until a case is shown in which no tenotomy has been done it will be impossible to judge of the merits of Dr. Ziegler's ingenious procedure.

Dr. Ziegler said, in reply to Dr. Hansell, that he purposely did not converge the sutures before anchoring, as this would distort the tissues at the point of fixation and would not maintain the parallel traction which he considered an essential factor in securing a good result. He thought the use of perforated metal plates at the point of muscle-fixation might help to secure this parallelism. De Wecker in his capsular advancement preferred to spread his sutures when he anchored them.

Dr. Peter's inquiry elicited the information that the sutures are always placed on the outside of the conjunctiva as parallel splints.

Replying to Dr. Holloway's query as to the type of suture used, Dr. Ziegler stated that it was a single stitch but double armed, preferably of No. 1 braided silk, paraffined.

In answer to Dr. Zentmayer's query as to how much of the effect is due to advancement of the muscle and how much is due to division or weakening of the opposing muscle, it is only necessary to measure the effect of the advancement as soon as the operation is completed, providing binocular vision is good enough to elicit diplopia. Dr. Ziegler always uses the von Graefe test with the Greek cross test object.

He was planning to use capsulomuscular advancement to supplement partial tenotomy in a case of esophoria where the external rectus was sliding and showed signs of inherent weakness. A hyperphoria of P-10 degrees had been corrected by

partial tenotomy. An esophoria of P-20 degrees later developed and was corrected in the same way, but had slid off again about P-15 degrees. As the right external rectus had a halting action it was proposed to correct this weakness by this type of advancement instead of doing another partial tenotomy on the other internal rectus.

He wished to emphasize the need of searching for capsular adhesions on the side of the contracted muscle which often nullify all efforts to correct the strabismus. This can be done by passing the tenotomy hook through a small incision in the conjunctiva and exploring the tissues both above and below the muscle. If the hook fails to pass freely the scissors can be slipped into the conjunctival opening and the adhesion gently divided without disturbing the relations. It is often surprising how this simple maneuver may convert an apparent failure into a success. In this case it relieved the hypertropia chiefly.

Electrically Tinted Optical Glass

Dr. Sidney L. Olsho (by invitation) presented specimens of optical lenses treated by exposure to *x*-rays produced by a special self-rectifying, air-and water-cooled tube in an apparatus recently perfected. Under this process American crown glass assumes a light amber tint after an exposure to 100, 50 K.V. for two minutes. Longer exposure deepens the color. The process is therefore under control. German optical glass develops an amethyst cast.

The lenses are treated after they have been ground and completely finished, hence an even tint develops throughout, regardless of variation in thickness—a strong minus lens is not darker at the periphery nor is a strong convex lens darker in the center. One-piece and fused bifocal lenses are evenly tinted, or the reading portion may be left colorless at will.

The effect is permanent under ordinary conditions, but may be removed again by the application of a high degree of heat.

The refractive index remains unchanged. The amber lenses so tinted show an affinity for the absorption of ultra-violet rays, surpassing, it is claimed, many of the lenses used for that purpose. They do not, however, as many other tinted lenses do, disturb color values. Lenses treated by this process are said, under the trade name, to be "Nutralited."

Dr. Zentmayer said: As I understand Dr. Olsho, this glass is an artificially produced amethyst glass offered as a substitute for amethyst glass produced by the action of the sun's rays on certain kinds of window glass. My recollection is that in the table put out by the Bureau of Standards, amethyst glass ranks low in its power of absorption of ultra-violet rays, whereas for this glass the claim is that it absorbs a very large percentage of these rays.

In reply to Dr. Zentmayer, Dr. Olsho stated that the chart submitted shows the affinity of these lenses for the absorption of ultra-violet rays. The amber-tinted lenses are the more effective.

Multifocal Lenses

Dr. Sidney L. Olsho (by invitation) presented specimens of finished multifocal lenses which are designed to take the place of invisible bifocal lenses and were first described to the Franklin Institute, in this city, by their inventor, H. O. Gowlland, of Montreal. The lower or reading portion of this lens presents a continuous variable curve. The periphery of the lower portion is indiscernible. From this periphery there is a gradual accretion of power to the reading center, the limit being the addition ordered. The lenses are Toric in form, ground on a constant—6°D. base, with additions up to 3 D. Any combination is secured by surfacing the other side.

The advantages claimed for this lens are: The possibility of embodying in one lens powers for the intermediate distances between infinity and the reading distance. There is no sharp jump

from the distance to the near focus. The wearer is supposedly able to select a focus for any intermediate distance at will, or may bring matter requiring the closest scrutiny into the zone controlled by the carefully positioned center. The field for close work is more restricted than in the ordinary bifocal, but this restriction is to some extent counterbalanced by the multiple range.

These lenses are known under the trade name "Ultifo."

Gruenow's Nodular Keratitis

Dr. William Zentmayer presented a woman, aged sixty-eight years, who had discovered accidentally four years ago that the vision in the left eye was much impaired. There was nothing in the personal or family history bearing on the ocular condition. The cornea of the eye showed a group of opacities of greenish gray, varying in size from ½ to 3 mm. and of different contours, one or more of them having a sigmoid shape. The lesions were situated immediately beneath the epithelium, which was elevated irregularly, giving to the surface of the cornea an unevenness. There was no ciliary injection and no history of past inflammation. The right eye showed the beginning of a similar condition. He expressed the belief that the process was probably a dystrophy, but doubted whether tuberculosis was an etiologic factor in this particular type of degeneration.

Central Exudative Retinitis

Dr. William Zentmayer exhibited a man, aged fifty-one years, married, one child living and well. Dimness of vision of the left eye was first noticed January 1, 1921. In November, 1920, he underwent an ocular examination in the railroad service, and the vision at that time was normal. The loss of vision was accompanied by marked metamorphopsia and halos. One year ago

the patient was ill for several weeks, the condition being diagnosed as nervous prostration. Aside from the ordinary diseases of childhood this was his only illness. No history of injury. Family history negative; von Pirquet and Wassermann negative. V. R. E., 6/5; L. E., 6/30. External conditions normal. Field of vision, right eye, slight temporal contraction; left eye, temporal contraction with a central positive scotoma. Ophthalmoscope: The right eye showed in the macular region a group of grayish-white, irregular-shaped lesions averaging about the diameter of the first branch of the vessels, occupying an area two-thirds the diameter of the disk and having somewhat of a rosette arrangement. In the left eye there was an exudation in the macula about four times the disk in size, with an elevation of about 1 mm. There was a corona of hemorrhage surrounding its margin. Because of the normal functioning of the right eye the lesion was looked upon as a hyaline degeneration. In the left eye the etiologic factor had not as yet been determined, but as the teeth are in an unsound condition it is possible that the condition may be one of focal infection.

An Unusual Case of Foreign Body Occupying the Orbit and Accessory Sinuses

Dr. T. B. Holloway gave the history of an injury to the right eye in a boy, aged sixteen years, by the explosion of a piece of wrought-iron pipe which had been loaded with powder. At the time of the explosion he was ten feet from the improvised cannon. Examination at the Wills Hospital, July 26, 1920, three weeks after the injury, showed a scar, 5 cm. in length, which extended across the middle of the nose. Moderate proptosis of the right eye and marked chemosis of the bulbar conjunctiva. Cornea hazy, anterior chamber deep, iris discolored, and pupil vertically oval and inactive. Complete loss of outward rotation and distinct impairment of the other ocular muscles. A grayish reflex from the vitreous by oblique illumination. Tension, minus 2;

no 1. p. No mass could be felt about the globe; there was slight tenderness over the lower and inner part of the orbit. Left eye negative, vision, 6-vi.

An *x*-ray examination revealed an enormous foreign body, the lower end of which appeared to be free in the nasal cavities with the upper end lodged in the orbit. As extraction from the orbit would be impossible without breaking down the inner wall, Dr. George Fetterolf was called in consultation. He reported "at nasal examination there could be seen and felt a metallic mass at the anterior part of the right nasal cavity between the middle meatus and the septum. Under ether a pair of strong forceps was applied to the mass and by the use of considerable force and after loosening by lateral movements withdrawal of the foreign body was effected. It proved to be a horizontal section of an iron pipe measuring 42 mm. in length by 12 mm. in breadth. Removal was followed by a small amount of bleeding."

When the patient was last seen on February 17, 1921, the globe still showed a slightly pinkish-yellow injection and distinct evidence of atrophy. No view of the fundus was possible.

An Illuminated Perimeter with Campimeter Features

Drs. C. E. Ferree and G. Rand, of Bryn Mawr College, exhibited an apparatus devised in response to a request from a committee of the American Ophthalmological Society for a feasible means of illuminating the perimeter arm with light of good intensity and quality, so that every point on the arm in any meridian in which it might be placed would receive equal intensities of light. Intensity and quality of illumination, however, are only two of the factors which influence the results of the perimeter determination. In devising the apparatus provisions have been made, therefore, for the control of other factors which are of importance. Some of these controls are:

1. Every point of the perimeter arm in any meridian in which it may be placed receives light of equal intensity and of approximately daylight quality by ammeter and rheostat control. The

instrument can be operated on any 110 volt circuit and the results obtained with it are absolutely independent of the variability of daylight illumination.

2. Provision is made so that the eye just before receiving the color stimulation is preëxposed to a surface of the brightness of the color as seen at the limits of the color field. The colored stimulus is surrounded also by a field of this same brightness. Variability in these two factors alone may change the limits as much as 20 degrees in some meridians. A further advantage is gained by making the background of the same brightness as the color: the stimulus disappears completely when the limits of sensitivity to the color is reached, instead of turning into a gray, concerning the colorlessness of which the patient is liable to be in doubt. This gives the effect of the disappearance type of photometer and adds greatly to the ease and certainty of making the judgment.

3. Accurate provision is made for maintaining the eye at the center of the sphere in the surface of which lies the perimeter arm and of holding a constant and steady fixation. The quick adjustment of the eye is facilitated by three rack-and-pinion motions. Constancy of relation of the meridians of the retina with the meridians of the field of vision as laid off by the perimeter arm is secured by an especially devised, shape-conforming head-rest.

4. An attachment is provided for controlling the fixation of patients with a central scotoma or pathologic blind area. With the eye properly adjusted for taking the field these patients are not able to see a central fixation object.

5. In order to provide for the mapping of the normal blind-spot, and for the quick determination and mapping of central and paracentral scotomata, a tangent screen is added subtending a visual angle of 60 or more degrees. This screen can be quickly and conveniently attached to the stimulus carriage and moved into position.

With the controls provided a careful worker can reproduce the limits of the color fields within 1 or 2 degrees.

Dr. L. C. Peter said it was essential to be able to take fields which can be reproduced. His preference for the tangent screen in perimetric studies has been due to the fact that peripheral field records, although not nearly so important as central studies, have been entirely unsatisfactory because of imperfect instruments. The sources of error in perimetric work from the clinical standpoint are illumination, variability of the intensity of the color stimulus, fixation, preëxposure and surrounding field. The perimeter exhibited seems to be as nearly accurate as its practical application in our routine office work demands, without complicating field-taking too much by technicalities which will tend to minimize its use. He hoped that some means could be found to have one firm control the manufacture of the instrument in order that uniformity in the intensity of the color stimuli and the grays necessary for preëxposure and surrounding field may be preserved. Without careful attention to this important feature of the perimeter much of its value will be missed. While Dr. Ferree did not discuss the size of the test object, he believed it should be designated in degrees or fractions of degrees rather than in millimeters.

Dr. Ziegler stated that he had found that electric illumination would yield results differing from daylight and inferior to it. In the first place the color values are wrong; secondly the color reactions differ from accepted standards, and thirdly, the fields are too large as compared with daylight findings. These deductions were based on the use of an electric perimeter with transilluminated colors. The Nernst lamp used In his surgical photophore gives normal daylight colors, but it is too large and too hot for perimetric illumination. He is now experimenting with small vacuum lamps covered by a special lens that restores the normal color values of daylight. If the latter plan succeeds a similar lens might be used for the illuminated perimeter.

Dr. Sidney L. Olsho offered the suggestion that the degree scales, on both perimeters and field-of-vision charts, be numbered so as to correspond to the scale on the trial frame. This makes for a needed uniformity. We are more accustomed to seeing the

vertical meridian marked 90 degrees, than we are to seeing the horizontal meridian designated 90 degrees.

The Variable Factors which Influence the Determination of the Color Fields

Drs. C. E. Ferree and G. Rand, of Bryn Mawr College, said that the variable factors which influence the apparent limits of color sensitivity are the wave length and purity of the stimulus, the intensity of the stimulus and the visual angle, the length of exposure of the eye, the method of exposure (moving or stationary stimulus), accuracy and steadiness of fixation, the intensity of the general illumination of the retina and its state of adaptation, breadth of pupil and the brightness of the preëxposure and of the background or surrounding field. The most important of these from the standpoint of the work of the office and clinic are the intensity of the stimulus, the brightness of the preëxposure and surrounding field, the intensity of the general illumination and the accuracy and steadiness of fixation.

Intensity of Stimulus. By a sufficiently wide variation in this factor alone the fields of color sensitivity may be made to have almost any breadth within the field of vision, to differ radically in shape and even to change or reverse their order of ranking with regard to breadth. For example, with very high intensities the limits of red, yellow and blue are coincident with the limits of white light vision. Green cannot be made to have so wide an extent. With stimuli of medium intensity and of the relative energies found in the prismatic spectrum of a Nernst filament, the limits are concentric and in the order from widest to narrowest of red, yellow, blue and green. With stimuli of medium intensity of equal energy the limits of red, yellow and blue interlace or criss-cross. The limits for green again are narrower. The limits for pigment stimuli may be either interlacing or concentric in the order of red, blue and green, or blue, red and green, depending upon the intensity of light falling on

the perimeter arm. It seems only fair to conclude therefore that the conventional clinic rating of the limits from widest to narrowest in the order of blue, red and green is a function of the relative and absolute intensities of the stimuli employed as well as of the actual distribution of sensitivities. Without great precision in the control of intensity it is obvious that reproducibility of result cannot be obtained and little significance can be attached to extent or shape of field, to order of ranking as to breadth of field, or to any variations from time to time or from person to person in these important features.

Brightness of Preëxposure and Surrounding Field. The brightness of the surface to which the eye is preëxposed may change the apparent limits in certain meridians as much as 17 degrees. A preëxposure lighter than the color gives a dark after-image; a preëxposure darker than the color, a light after-image. These after-images change profoundly the saturation of the color, also its hue. The brightness of the surrounding field, through physiologic induction, exercises a similar effect but not so great in amount. The variable effects both of the preëxposure and of the surrounding field are stongly influenced by changes in the intensity of the illumination. When the results are obtained under such ranges of change of illumination as may occur during the course of a given day or from day to day the variability of effect is greatly increased, reaching in some meridians as much as 28 to 30 degrees. Further important effects of the surrounding field as influenced by change of illumination are the changes in hue which the color undergoes in passing towards the periphery of the retina.

MARCH 17

The Modern Conception of the Anatomy of the Nasolacrimal Passageways in Man

Dr. J. Parsons Schaeffer, of the Jefferson Medical College, gave a lantern demonstration of the anatomy of the nasolacrimal

region. Owing to limited space, only certain phases of the subject can be given here.

The strand of thickened epithelium along the floor of the rudimentary naso-optic fissure represents the initial stage in the development of the nasolacrimal passageways. The strand or cord of epithelial cells grows into the underlying mesenchyme, becomes entirely detached from the surface and encompassed by mesenchymal cells. The cord at this time is entirely solid and without connection with the nasal mucosa and the free border of the eyelids. From the solid cord of epithelial cells sprout both lacrimal ducts, the nasal end of the nasolacrimal duct and the cephalic portion of the lacrimal sac. The lumina of the several segments of the nasolacrimal passageways are established in a very irregular manner. The ocular end of the mother cord of the epithelial cells is the first to establish a lumen. The point of coalescence between the nasal end of the cord and the mucosa of the inferior nasal meatus is the last portion to become patent, the lacrimonasal membrane "rupturing" approximately at term. The horizontal portion of the lacrimal ducts establishes lumina before the vertical portion.

Many of the anomalies and variations in the anatomy of the nasolacrimal passageways encountered in infants and in adults are easy of comprehension and interpretation if one recalls (*a*) that the anlage or rudiment of the nasolacrimal passageways is a solid cord; (*b*) that at one time the solid cord has absolutely no connection with the surface; (*c*) that the lacrimal duct, the cephalic portion of the lacrimal sac, and the nasal end of the nasolacrimal duct develop as secondary sprouts from the mother cord.

The cord of epithelial cells may at places remain solid, leading to atresias. One or the other of the lacrimal sprouts may fail to establish connection with the free border of the eyelid, giving rise to an absent duct. Multiple sprouts may grow to one or to the other eyelid, causing a duplication, triplication, etc., of the lacrimal ducts. Additional sprouts from the sides of the solid nasolacrimal duct form the genetic basis of the diverticula

encountered in later life. The coalescence of the solid lacrimal duct with the eyelids may be extensive, inviting the formation of a single, long, slit-like ostium and of multiple ostia. The lacrimal sac may at an early time come in contact with the surface epithelium; canalization at such point would lead to a congenital fistula. Arrested development in the obliteration of the ocular end of the naso-optic furrow may be a factor in congenital fistulæ. The several types of ostia nasolacrimalia in the inferior nasal meatus found in the adult are in accord with the potentialities of lumen formation at the point of coalescence of the solid epithelial nasolacrimal duct and the nasal mucosa.

The idea of an unvarying typical type of adult nasolacrimal duct and lacrimal sac, etc., must be abandoned. The newer anatomy of anatomic types is urged. This is more in keeping with the real anatomy than the notion of a typal form and all departures therefrom as anomalies. Recent investigations show that at least two important types of nasolacrimal ducts are encountered: One type is more or less regular in contour and in direct line with the lacrimal sac with which it gradually merges. The other type is very irregular, somewhat tortuous and not infrequently connected with the lacrimal sac in a side-to-side union. Both types of ducts may have diverticula of various sizes. However, diverticula are more frequently encountered in ducts with irregular walls.

The nasolacrimal ostium located in the inferior nasal meatus is extremely variable in its anatomy. Two very definite types, however, may be mentioned: One type is located at the highest point of the inferior nasal meatus, immediately caudal to the attached border of the inferior nasal concha. Owing to adherence of the mucous membrane to the osseous boundaries the nasolacrimal ostium stands permanently open, is wide-mouthed and unguarded by a mucosal flap or valve. Another type of ostium is located variously in the mucous membrane on the lateral wall of the inferior nasal meatus. Such ostia are slit-like and are usually guarded by a mucosal valve (valve of Hasner). Other variants cannot be discussed here.

In the endonasal operation on the lacrimal sac and upper segment of the nasolacrimal duct one must recall that certain of the anterior ethmoidal cells, especially the frontal and the infundibular, lie in juxtaposition to these segments of the lacrimal passageways. The same holds true for the prelacrimal recess of the maxillary sinus. These paranasal sinuses are readily opened into in this position. Of course, when the operation is done in the lower third of the nasolacrimal duct the paranasal sinuses referred to are not a factor.

Other factors being equal, it would appear from an anatomic viewpoint that an infected nasolacrimal duct and lacrimal sac would yield most readily to treatment in those cases in which the nasolacrimal ostium is large, permanently open-mouthed and unobstructed by anatomic conditions of the inferior nasal meatus; moreover, in which the nasolacrimal duct is free of mucosal ledges and diverticula. On the other hand, one would expect infected nasolacrimal passageways to resist treatment and the ailment to enter the stage of chronicity in those anatomic types in which the nasolacrimal duct contains diverticula (often without gravity drainage) and the nasolacrimal ostia are of small and inadequate size for efficient drainage; moreover, a nasal aperture or ostium so located that it is readily influenced by conditions of the inferior nasal meatus. The success or failure of nonsurgical treatment of the diseased nasolacrimal passageways is largely dependent upon the anatomic type of nasolacrimal duct and ostium encountered. In conclusion, the writer would urge the importance of the "anatomic type" clinically, not only in connection with the nasolacrimal passageways but elsewhere in the body.

Operation for Intranasal Obstruction

Dr. Sidney Yankauer, of New York (by invitation), discussed the recent operative procedures for drainage through window resections, and concluded that such procedures had usually failed to give permanent relief. He described his newer method of dissecting through intranasal obstructions without disturbing the lumen of the lacrimal canal.

Congenital Atresia of the Lacrimonasal Duct

Dr. William Zentmayer described the clinical manifestations, the complications and treatment of obstruction to the tear duct in the newborn, and stated that when cystitis develops it is due to secondary infection. While there may be several causes for the clinical symptoms, the usual one is the retention of the separated epithelial cells which go to make up the core from which the canal is later developed, due to imperforation of the septum (Hasner's valve) between the lacrimonasal duct and the nasal chamber. The affection appears immediately or a few days after the birth of the child, at which time a small amount of discharge is noticeable at the inner angle of the affected eye. Bulbar conjunctiva is usually normal or but slightly injected. There may or may not be fulness over the sac. Pressure applied over this region may cause a gelatinous white fluid to exude from the punctum or may be followed by a discharge from the nose. The affection is rarely bilateral. Nature in time usually corrects the trouble, but at any stage infection of the contents of the canal may result in the formation of an abscess. As one observer has found that 25 per cent of his cases of dacryocystitis occurred before the tenth year, it is likely that chronic dacryocystitis in the child may be looked upon as a sequel of untreated congenital atresia. As the possible results of delayed opening of the tear passages may be infection it seems wise to at once secure proper drainage. This is readily done by the passage of a small probe through the dilated punctum, the canaliculus, sac and canal into the nose. Local anesthesia only is required. One probing in the vast majority of cases is sufficient.

Newer Mercurial Preparations of Service in Ophthalmology

Dr. T. B. Holloway referred to mercurophen, the product of the dermatological research laboratory, which contains 53 per cent

mercury. He pointed out its very high bactericidal power as compared with other similar agents. In the laboratory tests it was shown to be some two hundred times more active than bichloride. He also referred to mercurochrome (220) and spoke of the laboratory investigations as conducted by Young, Swartz and White. Reference was then made to the comparative laboratory effects of these two drugs on the tubercle bacillus as reported by Dr. De Witt. She believed that mercurophen particularly might be used with benefit in certain ulcerative lesions on account of its high bacteriostatic power. The recent report of Lancaster concerning mercurochrome was also referred to.

Dr. Holloway stated that he had had much greater experience with the use of mercurophen than mercurochrome, although he was now using both drugs. He stated he had but little to add to what he had previously said in regard to mercurophen, but he believed this drug was most efficient against the pneumococcus, and as far as his experience was concerned, just as efficient as ethyl-hydrocuprein. While mercurophen seemed to be the more active of the two drugs, it should not be forgotten that this product was used in the strength of about 1 to 8000 as an irrigating fluid, whereas mercurochrome was used in the strength of about 1 to 500 and usually instilled by the drop method. He felt as so used there was but little difference in their bactericidal action as far as laboratory tests were concerned.

Dr. George E. de Schweinitz expressed his high appreciation of Dr. Schaeffer's admirable address. He was unable, he said, to discuss from the practical standpoint, Dr. Yankauer's well-described operation for the relief of dacryocystitis, as the technic was essentially one which belonged to the operative work of a rhinologist. With Toti's, West's and Mosher's operations he had had no personal experience. He maintained, as he had on previous occasions, that a well-performed excision of the lacrimal sac was an operative procedure of great value, which had given him satisfaction for many years, and which he believed in many circumstances was superior to any of the forms of intranasal operation to which reference had been made.

Referring to so-called dacryocystitis of infants—congenital atresia of the duct—he thought it might be arranged in two groups: (*a*) Those which disappeared without operation, the only treatment required being the instillation into the inner canthal area of a mild antiseptic fluid, followed after systematic evacuation of the sac contents by a gentle massage of the sac, and (*b*) those which required, in addition to this, the passage of a probe, readily inserted in the case of infants, to facilitate drainage.

He had found sulphate of zinc to be a useful collyrium, and had also employed argyrol, not, of course, by injecting it into the duct, but in the manner previously described. Recently, in several instances, he had employed mercurophen (1 to 10,000) for the same purpose, and also mercurochrome (1 per cent.). In a very few cases, owing to secondary infection, true purulent dacryocystitis supervenes in infants, and in these circumstances a more formal procedure may be required.

Dr. B. Alexander Randall said that it was at the suggestion of the late Samuel D. Risley that he made, in 1881, a study of the lacrimal puncta and canaliculi, especially as to the presence of a definite sphincter at the punctum. Dr. Risley believed that many an epiphora was greatly relieved by dilatation of this narrowed opening, and its behavior had strongly suggested a sphincter, although this was denied by many authorities. Both in longitudinal and cross-section such arrangement of the muscle fibers was clearly demonstrated, as shown in photomicrographs of Dr. Randall's preparations and by Merkel's picture in Graefe and Saemisch, and it was accepted by Leidy in his last edition. Among the eye instruments at the Episcopal Hospital, when he took charge there forty years ago, were lacrimal probes of von Hasner, a right and left aneurysm needle-like instrument for use from the nose up. With such von Hasner must have learned much practically as to the "valve," which he depicted and described in his book. Whether or not we accept his views, von Hasner deserves full credit for emphasizing the essential importance

of nasal inflammations, too generally ignored even today in this connection.

Dr. S. Lewis Ziegler suggested that Dr. Schaeffer should carry his investigations beyond the osteology into the distribution of the sympathetic over the hyperesthetic areas in the upper air chambers, especially of that area covering the septal tubercle, and of their relation to pituitary function and to ocular lesions. Septal operations in the danger zones immediately behind the tubercle may seriously affect the heart or cause muscular incoordination through a staggering gait, which leads us to infer that the pituitary may exercise a greater control over equilibrium than we give it credit for.

The plexus over the tubercle also controls sinus secretion. When properly cauterized it will relieve many cases of intractable dysfunction that would not yield to direct surgical attack. Sometimes sinus lesions recover spontaneously through mild sedative treatment of these sensitive areas. Many cases of ocular neuralgia and other severe head pains often yield to similar treatment.

The reflex neuroses that may originate in this area are multiple. I have long since called attention to the fact that muscular phorias are frequent sequelæ. Accommodative disturbances from this cause are so numerous that I am almost convinced that this paretic interference with the action of the ciliary muscle is more important than lens hardening. I am at present studying a group of these mixed lesions that I hope may help to elucidate this point.

Dr. Yankauer offers us a very practical technic, but I am not convinced that any form of window resection is sufficiently physiologic to overcome the fatal defect of destroyed capillarity and the consequent regurgitation of septic secretions. Unless the nasal chambers are freed from infectious sinus discharges there is always the danger of regurgitation or of forced expulsion on blowing the nose with all the menace to corneal integrity which naturally follows.

To illustrate: About thirty years ago I treated two patients

with overpatulous ducts and septic nasal secretions who suffered from corneal perforation and emptying of the anterior chamber whenever they mouth-breathed for two nights in succession. Occlusion of the mouth by adhesive strips gave temporary relief, but it was only by plastic reclosure of the ducts and radical intranasal treatment that recovery was brought about. I have seen one of these cases recently and the result is permanent. But the too-open duct was disastrous while it lasted.

I still believe that my method of rapid dilatation of the duct without incision is the best way of treating these cases, because the capillarity is preserved and the physiologic function is thus maintained. Even in babes the soft bones yield without fracture.

Notes on the Maxwell Operation

Dr. William Zentmayer described the Maxwell operation as he had performed it on both the upper and lower cul-de-sac in a patient, seen at Wills Hospital, with a greatly contracted socket, and on whom several operations of different nature had previously been performed at another institution without success. He had found from previous experience that no special care had to be taken of the elevator of the lid.

Device for Spectacles for Infants

Dr. J. Hiland Dewey showed a spectacle frame and basket-like contrivance for holding a pair of spectacles on a four months' old infant. The frame has short temple-pieces reaching to the temporal region, with a loop on the end of each for holding a short ribbon. From this ribbon runs three other ribbons, which pass around the head to the temple-piece on the other side, one ribbon below the occipital protuberance, one slightly above the first and the third considerably higher. These are joined by several vertical ribbons, which give it somewhat a basket-like appearance.

With the growth of the infant the attachment of the ribbon at one of the temporal pieces may be readily lengthened. In this way indentation of the nasal bridge is avoided.

A Suspected Foreign Body in the Posterior Chamber, Seen Through a Slit in the Iris but Not Shown by the X-Ray, and a Cilia Lodged in the Pupillary Space

Dr. Hunter W. Scarlett exhibited a young man who sought treatment in January, 1921, for inflamed eyelids of one week's duration. In both eyes there was a low-grade blepharoconjunctivitis, but examination of the right eyeball revealed an adherent leukoma running from the limbus at about 10 o'clock in toward the center for about 2 mm. A thick grayish membrane adherent to the iris filled the pupillary area. Incarcerated in this membrane was a cilia extending from the internal margin of the nasal side of the pupil, across the pupillary area into the anterior chamber, resting on the anterior edge of the temporal side of the sphincter irides. In addition, by focal illumination, there was a small radial slit in the iris, extending inward from about 7 or 8 o'clock, and at right angles to this slit a small shining body which resembled a piece of polished brass.

The patient gave the history of injury to the right eye in 1913 by a piece of metal while he was hammering a percussion cap, which exploded. He was immediately examined at the hospital by an oculist and a piece of brass was removed under general anesthesia. Since that time he had had only light perception in the eye. Following the removal of the metal, which probably was in the anterior chamber, an *x*-ray was made, with negative results.

Since his examination in January last three *x*-ray examinations have failed to reveal the presence of a foreign body in the eye. The case is shown because of the unusual form of the injury, the presence of the cilia retained in the anterior chamber during eight years without causing any apparent disturbance, and the suspicious substance lying beneath the iris in the posterior chamber.

Dr. William Zentmayer thought that the reflecting body seen behind the iris was a foreign body.

Congenital Bilateral Ptosis with Inability to Look Upward

Dr. Burton Chance reported the case of a negro, aged twenty-three years, with congenital bilateral ptosis, the edges of the lids covering two-thirds of the corneas. While the orbiculars reacted there was no action of the levators. When a test object was carried upward there was at once a tilting backward of the head and a sharp depressed convergence of the axes of the globes. When the lids were raised by the observer and a test object carried on upward the globes failed to follow it, but at once there set in a rapid rotatory nystagmic movement of the left globe. In the horizontal and inferior directions there was no interference with the ocular movements. Voluntary efforts at convergence were futile until, with the lids forcibly raised, the object was carried through an arc from 15 degrees below to 15 degrees above the horizontal. There did not seem to be voluntary oblique action. The eyes were normal in all other respects.

The mother and a brother, about ten years older than the patient, had the same deformity. A younger sister has normally acting eyeballs and eyelids.

APRIL 21

Retinal Detachment

Dr. Robert Scott Lamb, of Washington, D. C., read a paper, by invitation, on the non-surgical treatment of detachment of the retina, and gave in detail the history of a patient who had lost his right eye ten years previously through detachment, and

had lately through muscle strain caused retinal detachment in the second eye, As a result of the hospital and home treatment the patient was able at the end of seven weeks to read, and continued to hold this vision for a period of a year.

The line of treatment as outlined by Dr. Lamb was: (*a*) To change the character of the fluid coming through the eye by the use of sodium carbonate and sodium chloride by the Murphy drip; (*b*) the removal of fluid lying behind the detachment, by injections of cyanide of mercury, 1 to 3000 solution, 15 drops with 3 drops of acoin, once a week or ten days, depending upon the amount of reaction; and (*c*) increase in the intraocular tension by the use of thyroid, increased from $\frac{1}{2}$ grain three times a day to the point of tolerance. In addition, fibrolysin was used for the purpose of increasing the white blood corpuscles.

Dr. H. F. Hansell said that successful treatment of retinal detachment, like that of other diseases, is dependent upon accurate knowledge of etiology and of the morbid process underlying the disease. We must decide in any given case, in so far as we are able, the following: Is the cause essential shrinking of, or the formation of a band in, the vitreous? Is it degeneration of the retina itself following inflammation of the ocular tissues? Is it exudation, fluid or solid, between the choroid or retina? Is it a choroidal tumor? Or finally, is it stretching of the sclera as in myopia? It is manifestly wrong to attempt therapeusis, either operative or medicinal, on all or even the majority of cases according to one principle. Indeed, detachment of the retina should be considered rather as a symptom than as a disease. The so-called spontaneous cases are also symptomatic of a causative affection. Failure of treatment may therefore be ascribed to one or two causes, namely, ignorance of the etiology, and the impracticability of any line of treatment directed toward the symptom and not the disease.

Dr. Burton Chance stated that the history of the treatment of detachment of the retina is at once the opprobrium of and a challenge to ophthalmology. It is a reproach, in so far as so few cases have shown reattachment and even partial restoration of

function. In the course of the year one meets with many varieties of cases, not all of which can be diagnosed and treated so promptly with such brilliant results as in Dr. Heed's startling case of a few months back. It is not simply the separation of the retinal sheet from its apposition to the choroid with which we have to deal, else we should constantly find immediate progressive and permanent widening of the space in every case of perforation of the tunics of the bulb. Indeed, one is likely to be astonished to find surgical and other traumatism unaccompanied by retinal detachment. He would urge, therefore, that such a course of non-surgical procedures as Dr. Lamb has here outlined ought never to be neglected even after operations. He was greatly interested in the history of a case of wide detachment and disability, as told to him by Dr. Lamb, while in Washington early in February. When later he was given an opportunity to examine the patient the gentleman was able to read a magazine, and the funduses showed concavities free from distinctly raised retinæ.

Dr. Peter said that during the past few months he had had under his care a young woman, aged twenty-eight years, who developed, in the fifth month of pregnancy, rapid loss of vision, and was admitted to the Samaritan Hospital for observation. Induction of labor was decided upon and instituted. The patient's vision, however, became worse in both eyes and was reduced to simple hand movements at two feet. Examination revealed complete detachment of both inferior halves, with considerable elevation of the detached retina extending well up to the disk. In the upper halves there were numerous areas of beginning detachment. Systolic blood-pressure was 240 mm. As the "accoucheur" did not favor the use of hot packs the patient was transferred from the obstetric to the ophthalmologic department for treatment. This consisted of six weeks of absolute rest in bed, especially on her back. Bicarbonate of soda was administered by mouth daily. The patient received a hot-pack daily and free saline catharsis was employed. At the end of six weeks the patient returned home with complete reattachment of both retinæ, and the fundus at this time showed only minute atrophic spots

here and there in the attached areas and in the upper parts of the retinæ.

Dr. C. R. Heed stated that the case history presented by Dr. Lamb was not a selective one for the Müller operation. He felt that the present status of a patient presented before the Section at the December meeting substantiated the merits claimed for the scleral resection operation in proper cases. The patient's vision previous to operation was 6–lx, eccentric; one month after operation, 6–xxi; five months later, 6–xxi +, with full visual fields.

Choroidal Exudate Simulating a Foreign Body

Dr. Harold G. Goldberg again exhibited his case of choridal exudate simulating a foreign body which had been presented at a recent meeting. There was very little change in the appearance of the eye-ground at this time, the pigmented area was more sharply defined and the exudate more completely absorbed, so that it really had more the appearance of a foreign body than when first seen. The eyes, at this time, showed no signs of inflammation, and the vision had improved to within one line of normal.

Tendon Transplantation in Paralysis of the External Rectus

Dr. William M. Sweet presented a girl, aged seventeen years, upon whom a portion of the superior and inferior recti muscles had been transplanted for the relief of a complete palsy of the external rectus muscle which had existed from childhood, probably congenital. The technic of the operation was somewhat similar to that described by O'Connor. After the tendons of the three muscles had been exposed by a circular incision around the outer half of the cornea the external halves of both the superior

rectus and the inferior rectus muscles, with the overlying Ténon capsule, were cut off close to the sclera and firmly secured by separate sutures. Instead of joining the tendons of the vertical recti to separated strands of the externus, as suggested by O'Connor, the externus was completely severed from the globe, after the usual threads for advancement had been inserted. The severed tendon of the superior rectus was then sutured to the upper portion of the stump of the externus remaining on the eyeball, and the inferior to the lower portion, and the externus was then advanced in the usual way, somewhat covering the new points of attachment of the transplanted vertical recti. The cut edges of the conjunctiva were then sutured. The internus was not cut, as it was desired to note the effect of the transplantation with advancement of the externus. Prior to operation the convergence of the left eye was about 30 degrees, with no power of outward rotation. At the end of ten days the patient was able to turn the eye outward 20 degrees. A tenotomy of the internus was then performed. At the end of six weeks the effect of the several operations was a power of outward rotation as measured on the perimeter of 35 degrees.

Dr. L. C. Peter said the technic employed by Dr. Sweet in this operation simplifies the procedure which Dr. O'Connor adopted in his cases, and which he also used in his own case reported in the Section several months ago. Dr. Clarence Harris and others have used this same technic with good results. He believes it is essential that a tenotomy of the internus be performed at the time of the operation in order to remove the strain upon the stitches. Advancement of the external rectus is equally important even though there probably will be no innervation of the external restus because of paralysis of the nerve supplying it. There is considerable elasticity of the muscle which in itself will tend to hold the eye in primary position.

Dr. William Campbell Posey said that at the March meeting of the Wills Hospital Society he had exhibited a case of pronounced upward squint in the right eye of young man which had dated from birth. All downward motion in the right eye was

lost, except down and in, in which position the eye could be slightly depressed by the action of the superior oblique. Actuated by the success of Dr. Peter's reported case and with Dr. Peter's aid and counsel, Dr. Posey proceeded to transplant the inferior portion of the right external and internal rectus muscles upon the inferior rectus. Examination showed, however, that the inferior rectus muscle was absent, a few strands of muscle fibers at the point of normal insertion of the muscle into the globe being alone present. Hoping, however, that some action might be gained by the transplantation of a portion of the tendons above referred to, this was done, the end of the tendons being sutured to the muscle stump. Free tenotomy of the superior rectus muscle was made at the same time. The results were gratifying, the squint being entirely corrected, the eyes being on the same horizontal plane. Downward rotation for the right eye was also somewhat better. There was but slight reaction.

Traumatic Tenotomy of Inferior Rectus

Dr. P. N. K. Schwenk showed a patient, C. W., aged twenty-eight years, a carpenter's helper, who while at work, March 11, 1921, was hit in the right eye with the end of a board, severing the attachment of the inferior rectus from the globe. He was treated at the Chester Hospital, but the muscle failed to become united to the globe and slid backward into the lower cul-de-sac. When first seen at the Wills Hospital the eye could not rotate below the horizontal plane and the patient was annoyed by the diplopia. On April 14, under general anesthesia, Dr. Schwenk made a horizontal incision across the globe, dissecting well the conjunctiva below the attachments of the cicatrix and at the inner side of the globe. The cicatrix was then loosened from the eyeball, the dense cicatricial mass excised and the muscle with Ténon's capsule brought up and held in place by two hair-pin sutures. One end of the inner thread was passed under the tendon of the internal rectus and the other into the sclera back of the horizontal

plane and the thread tied. One end of the outer thread was passed under the tendon of the external rectus muscle and the other end into the sclera and the conjunctiva and tied. In order to do this a small slit was made into the end of the muscle and tissues so as to come up under the loosened conjunctiva. The patient has fairly good downward rotation, and at this time is free from diplopia. The stitches will not be removed until assured of muscle attachment.

Dr. George H. Cross stated that the case exhibited had originally come under his care, and when first seen the torn and bruised end of the muscle remaining attached to the eyeball was protruding between the eyelids. There was intense chemosis, and after the use of cold compresses a mattress suture was passed through this part of the muscle and an attempt was made to find the inner fragment of the muscle. Being unable to do so the muscle was fastened well back in Ténon's capsule, with the hope that we would be able to correct part of the hypertropia. Without our knowledge he was admitted to the Wills Hospital, and fortunately for him came under the care of Dr. Schwenk, who has obtained a perfect result by the unique method he has described.

Ptosis Operation; a Clinical Observation

Dr. Charles R. Heed reported the case of a boy, aged three years, affected with congenital ptosis of the left eye. He performed a Motais operation February 8, 1921. Three days after the boy's discharge from the hospital the suture supporting the lid cut through and the tongue of the superior rectus slipped back away from the lid. He performed a Hess operation upon the same lid March 24, 1921. The three suspensory sutures were removed twenty-three days after the operation, the lid presenting a natural appearance and free from irritation. Two days after their removal an abscess developed along the course of the external suture, the swelling from which obliterated the crease at the outer

half of the lid. The abscess was evacuated and prompt subsidence of the reaction was followed by perfect movement of the lid and a natural crease. Dr. Heed felt that sterilization of the sutures by painting with iodin before their removal might prevent such infections.

Dr. William Campbell Posey said he thought the Hess operation a procedure of great value and called attention to the fact that the sutures should remain at least three weeks *in situ*, to gain the maximum effect from cicatricial contraction. He also, in several of the cases he had operated on, excised a small elliptical segment of skin from the upper wound margin. This augmented the effect of the lid raising and also was often of value from a cosmetic standpoint, enabling one to make the folds of skin in both upper lids symmetrical.

Cavernous Sinus Thrombosis

Dr. Warren S. Reese reported two cases of cavernous sinus thrombosis, the first unilateral and secondary to an otitis media. Autopsy showed that the cavernous sinus had become involved by extension through the bone along the course of the carotid canal. The causative organism was the Steptococcus hemolyticus. The second case was bilateral and resulted from a nasal furuncle. Autopsy was not obtained.

The author reviewed the anatomy and the literature pertaining to thrombosis of the cavenous sinus, and expressed the hope that more attention may be given to early diagnosis and the development of operative measures, which heretofore have not been very successful, necessary to combat this otherwise usually fatal affection.

Dr. Hunter Scarlett referred to a recent article in the *Archives of Surgery* by Chisholm and Watkins, who collected 12 cases of cavernous sinus thrombosis while reviewing 50,000 histories of the John Hopkins Hospital. The three most common causes were found to be (1) marasmus, (2) trauma, and (3) infection,

the last-names the most frequent. The symptoms resulted from (1) venous obstruction, (2) involvement of the neighboring nerves, and (3) general sepsis. They found that only 7 per cent recovered without operation and 7 per cent with operation.

Snowball Vitreous Opacities

Dr. T. B. Holloway exhibited two cases of so-called snowball opacities of the vitreous, and stated that he thought at least two types of vitreous opacity should be differentiated, namely, the snowball opacities and the true cases of synchysis scintillans where we have a deposition of cholesterin crystals in the vitreous. During the past twelve years he had seen more of the former type than of the latter. He referred to six cases of snowball opacities that had come under his observation since his last report on this subject in 1917. He called attention to the recent microchemical investigations of Verhoeff, and while he agreed with this investigator's belief that it was a degenerative process, he questioned whether intraocularly angiosclerosis was the most important factor in its production. He felt that more stress should be put on the altered state of the blood and the conditions, whatever these may be, that are responsible for it.

Dr. William Zentmayer said that one of the patients exhibited by Dr. Holloway was seen by him at Wills Hospital about one month ago. The vitreous condition was then diagnosed as "synchysis scintillans." From a further study of the case he saw no reason to change the diagnosis. The opacities are of varying shape, apparently flat and surely scintillate. The retinal condition is one of albuminic retinitis of the arteriosclerotic type with hemorrhages. In the case, recently published by Dr. Verhoeff, Dr. Zentmayer had had the good fortune to examine the vitreous as prepared by Dr. Verhoeff for demonstration, and certainly the opacities were of such an appearance as to merit the term "snowball."

Dr. Burton Chance said that he had seen the classically de-

scribed cholesterin crystal cases more frequently than such as were characterized by Dr. Holloway as snowball opacities. The case of synchysis which he exhibited is, in his judgment, nearer to the type of the snowball or asteroid hyalitis than is the case of Dr. Holloway. Of this type he recalled six or seven cases he had seen, two of which were negroes. In all there have been more or less remote changes in the tunics; in none, however, were the changes so extensive as what are to be seen in Dr. Holloway's present case.

Dr. Holloway stated that he had already pointed out that the local conditions attending these two types of opacity were the same. He desired to call attention to the fact that these opacities did not have the metallic sheen or glitter shown by cholesterin, but that they appeared almost a dead white or possibly cream-colored, and then only when in focus; that the character of the movement of the two types of opacity in the vitreous was different; that the snowball opacity behaves much as a buoy and remained white just as long as it was in focus, and this stood out in contrast to the less regular fall of the cholesterin crystal with its varying scintillation.

OCTOBER 20

The Development of the Lacrimal Canal in Normal and Abnormal Conditions

Professor J. van der Hoeve, of Leyden, Holland (by invitation), showed with lantern slides how the lacrimal ducts develop according to the researches of Jouves, Matys, Contunni, Moneri, Schaeffer Fleischer, and especially Ask. In the early period of fetal life an island of epithelium is separated from the upper nasal part of the depth of the nasolacrimal groove. From this island sprouts develop, which grow up and down as solid cords—the nasolacrimal ducts and the lacrimal canals—which acquire a lumen at a much later time. In acquiring a lumen sometimes a part

of the duct remains solid, and especially this may be the case with the nasolacrimal duct at the entrance in the nose, causing congenital atresia with subsequent dacryocystitis in newborn. Nature itself usually cures the condition spontaneously, but it must be treated by pressing on the lacrimal sac about every half hour. If in the lapse of two weeks the obstruction is not relieved a small probe must be passed. If the obstruction remains, it may give rise to an incurable and disagreeable dacryocystitis.

The lacrimal ducts grow out to the lids and reach the free margin when the fetus is 35 mm. in length. The superior canal is the shorter and inserts in the nasal angle. To reach the lacrimal lake it has to push away the anlagen of the Meibomian glands, so that those glands in the upper lid, especially in its nasal part, are much closer to each other than in any other portion of the eyelids. They may overlap one another, as van der Hoeve showed in lantern slides of reconstructions of Ask. The lower duct in reaching the free margin of the eyelid cuts away part of the lid, with Meibomian and other glands, and the caruncle lowers itself entirely and takes a position opposite to the lid, in the semilunar fold. The caruncle is thus formed by the lower lacrimal duct—without the duct the caruncle cannot develop. This idea of Ask accounts, according to van der Hoeve, for a congenital aberration which he perceived in three patients. All had a nasal ankyloblepharon. The distance from the outer canthus was normal, but the inner canthus was 10 mm. larger than in normal persons of the same age, so that the eyelids were 5 mm. smaller than they should have been. The superior lacrimal point was present at its normal place, close to the abnormal internal canthus; the inferior lacrimal point, on the contrary, was just as far from the abnormal internal canthus as it ought to be from the normal, about 5 mm., consequently it did not dip in the lacrimal lake and the patients suffered from lacrimation. This condition can be explained by a congenital development. The anlage of the inferior lacrimal canal was too large, consequently a too big caruncle was separated from the lid, and this caused an irritation which made the lids grow together (ankyloblepharon).

There are authors, as Krischewiky, Halben, Kuöl, Krämer, and Depené, who believe that the epithelium of the free lid margin takes an active part in the formation of the canals, in that the entire canal, or at least a part, develops from the lid epithelium. One of the reasons which they give is the fact that in cases of coloboma palpebræ, sometimes at the inferior lid, the lacrimal point is found at the temporal side of the coloboma, and they reason that such would be impossible if the canals develop from the nasal side of the coloboma—they could not have crossed the coloboma. This seems to van der Hoeve to be poor reasoning, because the canal can grow around the gap, as is shown in one of those cases where fluid instilled in the inferior punctum reached the nose, so that as the canal developed it had grown around the coloboma. van der Hoeve mentioned a patient with an open oblique facial cleft from the interior eye-angle to the mouth, which latter cut all the soft tissues to the bone, so that it was impossible for the canal to grow around it, and still the inferior lacrimal point was at the temporal side. Pressure on the sac produced mucopus in the nose and in the cleft. Irrigation in the superior lacrimal point gave fluid in the nose and in the cleft; in the inferior point only in the cleft; so that it semed that a normal lacrimal apparatus was present, in which only the inferior canal was cut through by the cleft, which was proved by examination with the Roentgen rays. van der Hoeve referred the subject to Ask, and he made slides from a fetus, 35.5 mm. long, which he got from Bowman's laboratory, and he was so lucky to get cuts which proved that the canals reach the free margins of the lids without the epithelium of the lid being active in any way. To explain the condition in the child it was possible that: (1) The anlage of the lacrimal apparatus is double at both sides of the naso-lacrimal groove and grows together when the groove closes; if it remains open the both parts develop independently. (2) The influence which prevents the cleft to close causes a part of the anlage to come to the other side. (3) The temporal part has really grown down from the lid epithelium or up from the cleft epithelium. All these suppositions were impossible, because the

caruncle would have been where the inferior canal was, at the temporal side, whereas it was in its usual place at the nasal angle. This fact could only be explained by a normal development of the lacrimal ducts and a cutting through of the inferior canal by a secondary cleft. Therefore, van der Hoeve ventured the hypothesis that in this case the ducts had developed in the normal way, and that afterward a secondary cleft had developed, caused by amnion bands which had vanished entirely. We know that van Duyse and others explain many of the secondary open facial clefts by the action of amnion bands. But, if this is right, then we must have a great many possibilities according to the time and place where the cleft develops. Ask and van der Hoeve built up a scheme of these possibilities, and divided them in four parts:

1. Cleft is temporal of the anlage of the lacrimal punctum, so does not interfere with the apparatus or only cuts through the lacrimal duct.

2. Cleft is through the anlage. If this happens before the sprouts are grown out, about the sixth week of fetal life, we will find no lacrimal duct, canaliculus, or sac; if the cleft develops later we find ducts and canaliculi, but no sac.

3. Cleft interferes with the lacrimal canals either with the upper, the lower, or both. If this occurs early, before about the sixth week, when the duct has not as yet passed the dangerous spot, we find no lacrimal punctum; if it concerns the lower duct, no caruncle either; when it occurs later, the duct has passed the dangerous place and we find a normal canal and punctum, but cut through by the cleft. The inferior canal can end in the cleft or in the inner angle, nasal to the cleft, so that no space is left for a caruncle. Had the inferior canal already passed the dangerous place it may end so close to the cleft that no caruncle is present, or so far that a caruncle is formed. The caruncle is formed when the canal reaches the free margin, about the tenth week of fetal life, then the caruncle goes to the interior angle and reaches its normal place about the fifth to the seventh month. If the cleft develops after the sixth week, and before the fifth to the seventh

month, the caruncle cannot reach its place and remains either at the temporal side of the cleft; or is cut through in two pieces, one nasal and one temporal of the cleft; or is destroyed totally by the cleft. If the cleft develops after the fifth to the seventh month, the caruncle is in its place and the cleft only cuts through the inferior canal, as in the child which was the beginning of these reflections.

4. The cleft is temporal of the canals and either does not touch at all the lacrimal apparatus or cuts through the nasolacrimal duct. We can increase the amount of these possibilities *ad libitum* by making combinations of different disturbances of canals and nasolacrimal ducts. Ask has found a fetus with open horizontal facial cleft at the right side, through which the amnion ran. It was caught in the mouth and went up over the left side of the facies and cut in this an oblique cleft separating the eye and the eyelids in two parts, so that microscopically the inferior lacrimal punctum and the caruncle were at the temporal side of the cleft. Microscopically he found that a small part of the caruncle was at the nasal side of the cleft. The caruncle was cut in two pieces by the amnion bands. This demonstrated van der Hoeve's hypothesis. The latter found in the anatomical museum in Amsterdam under Director Professor Bolk, three feti. First specimen: Placenta connected to the head, nose cut through by the amnion bands, lacrimal ducts normal. (Scheme part I). Second specimen: Normal inferior ducts and caruncle, superior canal ending at the left side in the cleft, at the right side in cicatricial tissue, which destroyed the upper lid. (Scheme part III.) Third specimen: A fetus with no lacrimal ducts on one side. (Scheme part II.) At the other side a normal superior lacrimal canal, no inferior lacrimal point and no caruncle. (Scheme part III.)

The important conclusions of Prof. van der Hoeve's paper were:

1. Ask's investigations of the development of the lacrimal caruncle explain some congenital aberrations.

2. Most often facial clefts are of secondary nature and caused by amnion bands.

3. It is possible to point out by appreciating the conditions of the lacrimal canals, the nasolacrimal ducts and the caruncle the time in which the amnion bands have exercised such an influence that they formed impassible barriers for the lacrimal ducts or the caruncle.

Dr. J. Parsons Schaeffer said that he thought Professor van der Hoeve had given a suggestive, if not acceptable, basis for a small group of anomalies that have hitherto puzzled investigators in the field.

In a paper read before this Section, in March last, on "The Modern Conception of the Nasolacrimal Passageways in Man," Dr. Schaeffer considered the normal development of the channels from a solid cord of epithelial cells which early begin to grow (32-day embryo) from the epithelium lining the depth of the obliterated naso-optic furrow, becomes detached and sinks into the underlying mesenchyme. Under normal conditions this solid cord of epithelial cells, surrounded by mesenchyme, sprouts at both the ocular and nasal ends, the ocular sprout giving rise to the upper and lower lacrimal ducts, while the nasal sprout establishes connections with the mucosa of the inferior nasal meatus. A lumen is variously established in the solid mother cord and its secondary out-sprouts, ultimately resulting in patulous channels from the free borders of the eyelids to the inferior nasal meatus. The last part to become patent is the point of connection of the nasolacrimal duct with the inferior nasal meatus—the lacrimonasal membrane disappearing about term.

At the same time he discussed the various rudiment potentials and the possibilities of adnormal development and the development of anatomic types: At times multiple secondary sprouts are encountered. These readily account for supernumerary lacrimal ducts to one or both eyelids. Wide points of contact with the free borders of the eyelids can readily result in multiple lacrimal puncta, or if the wide point of contact becomes entirely canalized, the slit-like punctum results. The marked variations in the anatomy of the aperture of the nasolacrimal duct in the inferior nasal meatus is accounted for by the fact that the point

and type of contact of the embryonic solid nasolacrimal cord with the mucous membrane of the inferior nasal meatus is inconstant. At times the point of contact is at the highest part of the inferior nasal meatus, giving rise to the wide and permanently open-mouthed ostium, unguarded by a mucosal flap. Again, the point of contact is extensive along the lateral wall of the inferior nasal meatus, this resulting in multiple apertures or a single slit-like aperture guarded by a mucosal flap (valve of Hasner), etc.

The solid nasolacrimal cord, instead of presenting an even contour, not infrequently has protruding from it short, solid sprouts (the usual ocular and nasal sprouts mentioned before). He believed that these secondary sprouts or buds are in many instances potential rudiments of nasolacrimal duct diverticula which are encountered in the adult. Indeed some grow to become additional lacrimal ducts. Very many are early resorbed. Lumen formation of the solid epithelial cords occurs very irregularly, accounting for mucosal flaps and ledges within the nasolacrimal duct later. Atresias here and there of the duct may be the result of retention of an embryonic condition; always recalling that the nasolacrimal passageways are at one time solid epithelial cords.

It is, therefore, clearly obvious that the genesis of certain variations or anomalous states is to be found in rudiment potentials. Other variations, like absent nasolacrimal ducts for one or both eyelids, in whole or in part, result from an arrested development. The causes here may be intrinsic or extrinsic, probably the latter. They are not clearly defined in this connection. Moreover, rare variants doubtless are the result of phylogenetic retention of a more primitive anatomy.

Despite the foregoing there are a few anomalous states in the anatomy of the nasolacrimal passageways encountered that appear to have no basis in rudiment potentials, in arrested development nor in comparative anatomy. For examples, one now and them encounters a divided lacrimal duct for one or both eyelids, the lacrimal sac may be detached from the main nasolacrimal duct, the nasolacrimal duct proper may be found as two

discontinuous segments, etc. It appears certain that the division of a lacrimal duct or of the nasolacrimal duct proper occurs secondarily, that is, after the definitive connections are fully formed. In his former communication he spoke of the possibility of amniotic bands severing previously formed and continuous nasolacrimal passageways into secondarily discontinuous segments. Owing to the want of suitable material to substantiate his belief, he was unwilling at that time to hazard further discussion of them.

The researches of Ask on the development of the lacrimal caruncle are generally accepted as correct. Professor van der Hoeve and his coworker Ask have ingenuously used the developmental stages of the lacrimal caruncle in offering an interpretation of the obscure anomalies in question. The inferior lacrimal duct, for example, wholly grows from the mother cord of epithelial cells. When division of the duct in question into two discontinuous parts is found, some writers use it as an argument that the distal part of the lacrimal duct grows as an epithelial sprout from the free border of the eyelid and the proximal segment from the nasolacrimal duct proper.

It seems reasonably certain from the work of Ask and van der Hoeve that if a fissure is the cause of a division of the lacrimal duct into two parts, the fissure or furrow must be a secondary one. The naso-optic furrow is obliterated before this time; indeed, is in a very rudimentary state at the appearance of the very beginning of the nasolacrimal passageways (32-day embryo). The explanation for the fissure may be found in amniotic bands, and what before was mere conjecture and speculation now appears to have received strong support. Professors van der Hoeve and Ask not only present a theory, but tonight one of them has shown illustrations from actual tissues and patients in confirmation thereof. As to the question of time raised by Professor van der Hoeve, Dr. Schaeffer's belief was the division of the ducts occurs early. Unfortunately, most of the specimens shown this evening were from monsters. This would indicate, according to the studies of Mall and Stockard, early faulty environment of the

embryo. Mall also shows that the vast majority of human monsters are aborted before the sixth week. This may account for the relative infrequency in the newborn and child of the anomalous nasolacrimal ducts discussed tonight. It has been shown that pathological embryos that survive the eighth week very frequently continue through the normal period of pregnancy and be monsters at birth. Fortunately, Nature early gets rid of the majority of such undesirables. While additional studies should be made, Professor van der Hoeve's is the first plausible explanation for a certain and infrequent type of anatomical defect or variation that was unaccounted for hitherto.

Senile Changes of the Optic Nerve

Dr. Ernst Fuchs: First of all, I beg to thank the Ophthalmological Section of the College of Physicians and Surgeons for the honor done me by the invitation to read a paper before you. The subject of the paper is the senile changes of the optic nerve, especially insofar as they are capable of damaging the vision. One meets, now and then, with cases of reduced vision in old people either without any ophthalmoscopic changes which could account for it, or, maybe, with a slight pallor of the optic disk. If this could not be attributed to some manifest cause I used to describe it as senile atrophy and considered it as a benign form inasmuch as it never resulted in complete blindness.

In order to know what senile changes may occur in the optic nerve, I removed during the last few years in the postmortem room, from the bodies of persons over seventy years old, the eyeballs together with the optic nerves, the chiasm and the optic tracts, and examined them in serial sections. The senile changes found in these cases were of three classes:

1. *Amyloid Bodies*. They are very often confounded with the arenaceous bodies. The arenaceous bodies originate from the endothelial cells lining the arachnoid sheath of the optic nerve and are therefore found in the intervaginal space. They exhibit

a laminated structure and are many times larger than the amyloid bodies. The latter are of a homogeneous structure and owe their name to their staining with certain stains in the same way that starch does. There is a pretty general consensus of opinion that they develop exclusively from neuroglia, so that they are found only where the supporting tissue is formed by neuroglia, *i. e.*, in the central nervous system. There we meet them without exception in all old persons, although in a varying degree of frequency. The optic nerve being an advanced part of the brain, they must be expected to be present also in it. Now one never finds them in that part of the optic nerve which remains with the excised eye and which is mostly the only portion of the optic nerve examined. Obersteiner, however, has shown that they are quite frequent in the intracranial portion of the nerve. There I found them sometimes in great numbers—in one case more than 1500 in each cross-section of the nerve, being equally numerous also in the chiasm and in the optic tract. At the entrance of the optic nerve into the optic canal their number decreases very suddenly and in the orbital division but a few may be found and then only in the posterior part of it. If they are as numerous as in this case, their entire number in the optic nerve, chiasm and optic tract together may be estimated as several millions. Now the diameter of these bodies is so great that it occupies the space of 8-13 fibers of the optic nerve, which are pushed aside by the bodies. If they are so abundant in the above case, each fiber must be displaced several times by the bodies it meets on its way and may so become damaged.

2. *Sclerosis of the Vessels.* This was present in a varying degree in all cases examined and was very advanced in some of them. The internal carotid artery and, branching from it, the ophthalmic artery are seated at the inferior side of the intracranial portion of the optic nerve. These vessels are often dilated and their wall thickened or even calcified. Then they exert a pressure upon the lower side of the optic nerve, which however is prevented from giving way by the pressure of a very tough fold of the duramater, which extends from the upper circumference of the posterior

orifice of the optic canal backward so as to form a sort of prolongation of the canal, so preventing any upward displacement of the nerve. Therefore the pressure of the ophthalmic artery effects a flattening on the lower side of the nerve or even a depression which in some cases becomes so deep as to divide the nerve into two separate parts, the nerve bundles between them becoming completely destroyed. This determines a loss of the nasal half of the field of vision, and, if the lesion is bilateral, a binasal hemianopsia, which therefore, if it occurs in old people, is indicative of a damage done to the optic nerves by a sclerosed ophthalmic artery.

3. *Atrophic Foci.* They can be recognized as such already in an early stage in sections stained by Weigert's method, in which the focus stands out by its lighter color because of the disappearance of the medullary sheaths. Later on the axis cylinders also perish, the entire nerve bundles become smaller and smaller, and in proportion the septa between them thickens, so that in advanced cases they may coalesce. If, as usually happens, the focus is located at the periphery the nerve flattens out at the site of the atrophy. I have found such foci of atrophy in nearly all nerves examined, often two to four in one nerve. Most of the foci occur in the division of the nerve which lies in the optic canal or near its anterior or posterior orifice. The size of the foci is varying; some may be so large as to occupy nearly one-third of the thickness of the nerve and may attain a length of 15 to 10 mm. The atrophy is always most advanced at a definite point, from which it extends upward and downward, the acsending atrophy being always three to four times longer than the descending. As to the cause of the atrophy, it could not be the disease from which the persons had died, as these diseases varied greatly in character in my cases. There was only one morbid change common to all cases, namely, the arteriosclerosis, which therefore I take to be the cause of the foci of atrophy. Behind the entrance of the central artery the nerve is supplied with blood by small arteries, which penetrate from the pial sheath into the nerve, together with the connective tissue septa. These arteries are terminal

vessels, so that if they are obstructed by sclerosis the blood supply becomes insufficient. Then the delicate nerve fibers perish, whereas the more resistant connective tissue of the septa survives.

As the atrophy attacks as a rule the peripheric bundles it ought to manifest itself by a peripheral contraction of the field of vision. This however may easily remain unnoticed by the patients, especially if their vision is already impaired by other changes due to old age.

Dr. Edward Jackson, of Denver, said: In expressing high appreciation of the address Professor Fuchs has made to us this evening I can safely claim to speak for every one who heard him. Heretofore, when an elderly patient showed deteriorating vision without any recognizable cause for the visual impairment, we have called it "senile amblyopia," and rested quite satisfied with the diagnosis. The discovery of the corpora amylacea in the intracranial portion of the senile optic nerve gives a new definiteness to our conception of senile failure of vision, and the starting point for additional researches as to the etiology and possibly the prevention of such changes. Such results of painstaking research carry the lesson which we American ophthalmologists most need to learn: That careful studies in pathologic histology still need to be made with reference to many conditions, and promise results that will revise and advance our conceptions of disease and bring about practical modifications in prognosis and treatment.

NOVEMBER 17

Avulsion of the Optic Nerve

Dr. B. F. Baer, Jr., exhibited a young man who in May, 1914, was shot in the right temple with a bullet from a 32-caliber revolver. The bullet passed across the right orbit directly back of the right eye, through the nares and the left orbit. Immediate blindness of both eyes, ptosis of the left upper lid and paralysis

of the superior rectus muscle on the left side occurred. The blindness in the right eye has remained permanent. Five months after the injury vision had so far improved in the left eye that large objects were discernible, the patient stating at that time he could recognize individuals but was unable to read print. In the spring of 1919 he was struck in the left eye with a piece of wood, as a result of which a traumatic cataract developed. In the fall of 1919, a Tansley-Hunt operation was performed on the left upper lid with good effect, and at a later date an attempt was made to remove the cataract.

Present Condition.—Right eye: Pupil widely dilated and non-reactive. A few fine vitreous opacities. At the posterior pole of the eye is a whitish area, irregularly round and about three times the normal disk in size. This area is completely ringed by a band of choroidal pigment. Superimposed in the center of the whitish area is a mass of proliferating retinal tissue in which are a number of small adventitious vessels. The entire periphery of the fundus shows widespread disturbance of the choroidal pigment. The retinal veins are greatly contracted and can be traced to the edge of the whitish area. The retinal arteries are absent. The left eye presents a narrow, upward coloboma (operative) and the pupil space is filled with a thick secondary membrane through which no view of the fundus nor fundus reflex is obtained. Vision in this eye is light perception in the temporal field only.

Dr. William Zentmayer stated that he had exhibited the patient before the Section in 1919, with a diagnosis of avulsion of the optic nerve. The fundus of the right eye was little changed since then. The lesions present are largely those due to proliferative retinochoroiditis, such as was frequently observed in France during the war. In the left eye an iridectomy has since been made, with the hope of improving the vision, which at the time of the operation was L. P. The patient states that he has now form vision.

Exhibition of a Muscle Indicator

Dr. Edwin B. Miller (by invitation) exhibited and described a device for the purpose of simplifying the study of the ocular muscles, and especially to visualize the exact position of the muscle in action, in plotting the diplopia field, and to pick out the faulty muscle in the search for the cause of the various forms of muscle imbalance. It is based on the classification of Duane, who divides the twelve ocular muscles into three groups of four muscles each—the elevators, the depressors, and the lateral turners; and then subdivides each group into two—the right-hand elevators, the left-hand elevators; the right-hand depressors, the left-hand depressors; the right-hand turners and the left-hand turners. The indicator consists of two wooden tongue-depressors nailed together to form the letter T, and several pieces of cardboard mounted on pins to represent the midsection of an eye, and several to represent the true and false images, with two red arrows which point out the direction of the diplopia, the direction of the separation of the true and false image, the direction of the limitation of movement of the eyeball, and the location of the paralyzed muscle. On the central portion of the horizontal bar there are four pieces of cardboard mounted on pins, two black to represent the true, and two red to represent the false image, in disturbance of the lateral turners. On the ends there are two larger cards on which there is a diagram showing the position of the true and false images in paralysis of the elevators or depressors. The patient is examined in a dark room. The operator, standing about ten feet in front with a candle or small electric lamp to elicit the diplopia, determines the position of the double images. The indicator is held face up, and the red arrow is turned in the direction of the false image, as shown on the horizontal arm. The examiner now reads off the various symptoms indicated and determines the affected muscle.

Dr. Luther C. Peter said: As Dr. Miller has pointed out, the indicator is an aid in checking up the correctness of the diagnosis

as to which individual muscle or muscles are paralyzed. He has not included in the mechanical device all the data which this indicator will truthfully represent if the scheme is slightly modified, as he has omitted in his paper vicarious rotations of the head. The face rotations should be clearly and definitely separated from the tipping of the head to the right or left shoulder. The tipping of the head to the right or left shoulder is more in the correction of the obliquity of the false image than in the correction of the vertical diplopia. The face rotations are an effort on the part of the patient to bring the binocular vision in the field of least diplopia, or to place the eyes in such a position that the paralytic muscle operates but little, if any, and the diplopia may even disappear. Dr. Peter thought that the phrase generally used in tabulating ocular muscle palsies which states, "in the direction of the physiologic action of the paralyzed muscle" or "opposite to the physiologic action of the muscle" should have added "with the eyes in the primary position."

Embolism of the Central Retinal Artery

Dr. Charles E. G. Shannon exhibited a male patient, giving the history of a sudden loss of sight in the right eye. Four days following the attack of sudden blindness, examination revealed loss of light perception; pupil moderately dilated and sluggish in reaction; disk hazy and pale; margins obscure; arteries contracted; and a large, ill-defined, whitish patch in the macular region, with a small hemorrhage to the temporal side. No cherry-red spot. Enlarged and diseased tonsils were found and removed. No evidence of cardiovascular disease. Wassermann, blood and spinal fluid negative; urinalysis negative; *x*-ray of teeth, sinuses and head negative; von Pirquet negative.

Within four or five days there was a slight restoration of vision, which reached 8/200 eccentric fixation. There was an absolute central scotoma which still persists.

Treatment consisted in iodides and deep massage. Endar-

teritis proliferans should be considered as a possible diagnosis, as no discoverable lesion was found. In view of the sudden and complete loss of vision, the pallor of the disk, contraction of the arteries and opacity of the retina, a diagnosis of embolism appeared proper.

Obstruction of the Central Artery of the Retina from an Unusual Cause

Dr. George H. Cross reported the case of a man, aged twenty-nine years, a watchmaker, who on arising April 24, 1921, discovered that the right eye was almost completely blind. Nothing unusual or out of the ordinary happened the day or week before this occurrence.

Examination: Opthalmoscope. O. D.—media clear; pupillary reaction very sluggish; disk margins obliterated; veins reduced in caliber, the larger arteries reduced to a thread. This condition prevailed throughout the fundus, which was anemic with marked paleness of the outer half. Macula stands out prominently as a cherry-red spot. In the lower center of the fundus is a large, irregular, pale, greenish-white area with a heavier border on the lower margin, quite typical of the condition described by de Schweinitz, quoting Coats, as ischemic necrosis. There were numerous tuftlike hemorrhages in the central fundus and there was noted on some of the arteries a marked periarteritis. Wassermann was negative to four antigens. A blood culture showed no growth. White blood count showed 12,000 leukocytes; polymorphonuclears, 65 per cent; lymphocytes, 31 per cent; large mononulcears, 1 per cent; eosinophils, 3 per cent. Urinalysis showed nothing unusual. Repeated examination revealed a gradually increasing cloudiness of the vitreous until all details of the fundus were obscured.

May 16. A large area of punctate deposits in the lower third of the cornea was noted in conjunction with a thin ringlike exudate on the posterior lens capsule.

June 15. Patient can now count fingers; cornea again clear; media permitting a view of the fundus; vision equals counting fingers peripherally. *X*-ray examination of the teeth showed no pus pockets nor areas of absorption.

September 27. Vision in right eye, 15/70. Vision in the left eye, which was unaffected, 15/15.

Causative Factor. For three months prior to the sudden loss of vision this man had a bone-felon on the right thumb, which persisted in discharging purulent material until a large sequestra of dead bone was removed, this taking place after the ocular changes had developed. Inasmuch as the eye condition denoted an infective process and a physical examination revealed no other possible cause, it was decided that this obstruction of the central artery of the retina was in all probability due to a septic embolus.

A Composite Astigmatic Chart

Dr. Luther C. Peter exhibited an astigmatic chart which he had modified from that suggested by Dr. Walter B. Lancaster. The chart is made of standard wedding-stock cardboard and a narrow black baby-velvet ribbon, and has a diameter of 15 inches constructed on 15 degree intervals. Instead of pasting the ribbon on the cardboard, as suggested by Dr. Lancaster, it is passed through small openings at both ends and fastened upon the back of the card. Here and there the lines are tacked to the cardboard by black thread. As the patient finds difficulty in selecting only a few lines, which are almost equally black, the author, to reduce the number of lines to a minimum, constructs the chart so as to rotate. Lines above and below are marked on the rotating chart, and on the background at $7\frac{1}{2}$ degrees intervals. If five lines, for example, are picked out, a rotation of the entire board $7\frac{1}{2}$ degrees to the right, or $7\frac{1}{2}$ degrees to the left, as the case may be, will enable the patient to reduce the number of black lines, in many instances, to two and three, and the exact axis of the astigmatism is more readily selected.

In a second chart Dr. Peter combines the "V-Chart" of Dr. Maddox, which consists of two lines of the same black velvet ribbon fastened to cardboard at right angles. To the end of one of these lines is attached a V, constructed of cardboard and ribbon and placed upon a cardboard $3\frac{1}{2}$ inches in diameter. If the patient, for example, has selected on the first chart the lines 75, 90, 105, and 120 as the black lines, the second chart is put in place, with the V approximately within this area, from 75 degrees to 120 degrees. The patient very readily recognizes a difference in the shade of the two sides of the V, if the V has not been placed in the proper axis. The darker side is in the direction of the correct axis. The V is, therefore, rotated from one side to the other until both sides are equally black, when the axis is read off.

These charts were not presented to take the place of the usual examination with a cycloplegic, which must necessarily be employed in practice. They were presented only as an aid to reduce the time of work and the many vexations which arise in difficult refractions.

The Results of Cataract Operations Performed by Colonel Smith at Wills Hospital

Dr. William Zentmayer read a paper summarizing the results obtained and the complications during and after the operations.

Visual Results. Two cases, 6–vi; two cases, 6–xii; three cases, 6–xv; four cases, 6–xx; two cases, 6–xxx; two cases, L. P.; one case, vision not recorded.

Complications: Loss of vitreous, 38 per cent of total cases; incarceration of iris, including two cases of prolapse, 38 per cent; secondary glaucoma, one case. Abscission of iris was necessary in two cases; in one case iridotomy was required. In most of the cases there remained either vitreous haze or definite vitreous opacities.

It appeared to Dr. Zentmayer that there were many admirable points in the technic which could be used in other methods of

cataract extraction, for which we should feel grateful to Colonel Smith. The method employed in flushing the cul-de-sac, the control of the obricularis muscle, and the manner in which the upper lid is held away from the globe, permitting the delivery of the lens with the eyeball rotated upward—instead of downward as in the older methods in which a spring speculum is commonly used—are all advantageous.

Features which impressed Dr. Zentmayer unfavorably were: The strength of the bichlorid solution (1-3000) employed; insufficient anesthesia in some cases; the manner in which the knife was used in making the corneal section seemed to cause an unnecessary drag on the structures of the anterior part of the globe (it seemed not to be the way in which a knife was intended to be used); the technic of the iridectomy, devised presumably to keep the forceps out of the wound, while ingenious and effective in Colonel Smith's hands, is at the expense of unnecessary injury to the corneal epithelium; the amount of force often required to deliver the lens, and the incomplete toilet of the eye.

The discussion which followed the reading of Dr. Zentmayer's paper was participated in by Drs. de Schweinitz, Radcliffe, Schwenk, and Chance. The conclusion reached by each of these surgeons was that the operation for extraction of cataract by the Smith-Indian method, based upon the results in the group of cases operated upon by Colonel Smith at Wills Hospital, was not to be recommeded. It was recognized, however, that the trained assistants who constitute a most important adjunct to the Amritzar clinic would have been a valuable aid in securing better operative results.

Color Vision

Dr. Burton Chance read a paper treating somewhat in detail on certain chapters in the fundamentals of color vision. He dwelt upon the history of the study of color sense in order to bring out the salient points in the progress of the study by observations made upon children, aboriginese, animals, birds, insects,

and fishes. He referred to the features of the spectrum; of the parts of the eye concerned with color perception; the modifications of the sensation as effected by light and darkness; as well as to the changes in the ocular structures produced by light.

This résumé was given preliminarily to a proposed later study of color blindness and an exposition of the various theories of color vision.

DECEMBER 15

Complete V-shaped Discission for Zonular and Pyramidal Cataract

Dr. S. Lewis Ziegler exhibited two eyes operated on by complete V-shaped discission which were typical examples of slowly absorbing cortex due to calcareous deposits, and revealed the possibility of reclosure of the capsular sac from this cause, interfering with rapid solution of the lens substance, and in one instance requiring a secondary capsulotomy.

The patient, a female, aged five years, had always twisted her head in order to see from the left eye. The right eye showed typical zonular cataract, with sharply defined central pyramid of chalky whiteness. Apex, elevated and calcareous; surrounding cortex opaque, but periphery clear. Vision, 1/200, doubtful. Complete V-shaped discission was performed, but the cortex dissolved slowly, owing to its calcareous nature, and the capsule could not retract as freely as usual. Five months later, secondary capsular cataract with calcareous pyramid persisting. V-shaped capsulotomy was performed, allowing calcareous nodule to drop down and back and leaving pupillary area perfectly free. Vision, with sph. + 8. D = 15/200.

In the left eye there was pyramidal cataract, with small white nodule in center of anterior capsule and faint haze in surrounding cortex. Vision = 10/200. Complete V-shaped discission was performed, and on the third day the lens was fully opaque, push-

ing forward against iris and causing it to bulge. Eye free from reaction or other evidence of ciliary pressure. Seven weeks later absorption was found to be more rapid than in right eye, but slower than in the average case.

Plastic Operation for Cicatricial Ectropion

Dr. T. B. Holloway exhibited a patient who had been injured by a wire rope containing a number of broke strands, which had broken the nasal bones and lacerated the skin and the upper and lower lids of the right eye. At the time of coming under observation in November, 1920, there was a scar at the inner portion of the left upper lid, slight notching at its center, with a long scar that extended up and out across the tarsus and conjunctiva. The lower lid at its center showed a V-shaped defect completely through the tarsus, and attached to the notch of the V was the apex of a symblepharon which extended from the fornix and bulbar conjunctiva. There was an entropion of a portion of the lower lid, adjacent to the outer limb of the V. The inner portion of the lid was everted, with marked curling outward of the ends. There was also a defect at the lower portion of the internal canthus.

The first operation was performed in March, 1921, when the method suggested by Duverger was utilized with a most satisfactory result. A similar "halfing" procedure was described by Wheeler in 1919. In July a somewhat analogous V-shaped operation was done at the internal canthus, associated with a sliding flap taken from the side of the nose. This was done to give additional tissue in case of cutting out of certain sutures. On November 8 a very slight defect remaining at the internal canthus was corrected, with a final result that might be regarded as perfect, with complete restoration of the lower lid and conjunctival cul-de-sac.

Amaurotic Family Idiocy

Dr. T. B. Holloway exhibited a Jewish female infant, aged fourteen months, the third child of healthy parents, without a history of consanguinity. The other children were perfectly healthy. The infant was born after normal labor, and continued to do well until the age of six months, when she developed whooping cough, and since that time has never regained her strength.

The child does not hold her head erect and has not made any attempts to sit or stand alone. The head can he held up, but after a few minutes has a tendency to fall forward. The arms are usually kept extended and the fingers flexed. The grip of the hands is fair; when the arms are elevated and then released they fall listlessly. At times one can note a slight athetoid movement in the forearms and hands.

An amaurotic stare is quite evident. No defects can be determined in the ocular rotations. The pupils are semidilated and do not react to light. In each eye there is a well-defined optic atrophy associated with characteristic macular changes, the diameter of the gray-white zone being about one and a half times that of the disk.

Dr. Holloway referred to the early reports before the Section made by Drs. Shumway and Buchanan, as well as later reports by the latter and Dr. Appleman. He referred to the pathologic changes observed by Holden, Shumway and Verhoeff, as well as exceptions taken by Coats after the statement made by Batten and Mayo concerning the analogy between these cases and family cerebral degeneration with macular changes, particularly as this relates to the existence of edema.

Dr. William Zentmayer said that it would appear from a case observed with Dr. Weisenburg, that when the child lives beyond the usual limit of two years the macular changes may disappear, leaving only optic atrophy. Under these circumstances it makes it difficult to reach a neurologic diagnosis, as it is well known that in certain cases a differential diagnosis of this disease is dependent on the typical ocular findings.

Keratitis Profunda

Dr. H. Maxwell Langdon gave the history of a girl, aged twenty-five years, with irregular haze of the center of the cornea, about 5 mm. in diameter, not staining with fluorescin, and with ciliary injection but not much pain. All physical tests were negative. The blood examination indicated a moderate anemia (hemoglobin, 70 per cent; red blood corpulses, 2,992,000; white blood corpusles, 3000). There was an advanced atrophic rhinitis.

At the end of two weeks the infiltration became more dense. One month after the first examination the eye was exposed to three one-minute applications of radiant heat from Shahan's thermophore, the thermometer recording 160°. In seventy-two hours the temporal portion was thinning, and in one week the outer half had absorbed, leaving a thin superficial haze. Ten days later a second application of radiant heat, at 180°, was given, and in seventy-two hours there was absorption of the remaining portion of the dense haze; in ten days only a small spot, less than 1 mm. in size, directly before the pupil, remained. After a third treatment the haze entirely disappeared, leaving a thin film apparently just below Bowman's membrane. Nasal treatment was continuous, and under tonics the blood condition improved. Dr. Zentmayer saw the patient, and considered the condition as typical of keratitis profunda.

It seemed probable that the anemia was secondary to the rhinitis, and that absorption from the nasal condition was the cause of the keratitis. The prompt resolution of the exudate in the cornea following each "heating" seemed to have been a direct result of the treatment, possibly by producing the death of bacteria, if there was an actual invasion of the cornea by them, or an absorption of inflammatory exudate by increased circulation. The thermophore was held just close enough to the cornea to avoid contact.

Shall Pennsylvania Make Compulsory the Application of Silver Nitrate to the Eyes of Newly Born?

Dr. Edward Martin, Commissioner of Health of Pennsylvania, said that the Department of Health desired to bring to the Section for answer a simple question: "Shall or shall not legislation be passed which requires the silvering of every newly born baby?" It is generally, though not universally, accepted that this silvering, properly applied, will prevent the development of an infection acquired during birth. It is further generally accepted that if the infection be gonoccocal in nature and virulent in its course blindness may result, and so does in sufficient number to contribute about 10 per cent to our blinded population. Would this 10 per cent be reduced to the vanishing point if the eyes of every child were silvered immediately after being born? Would it be reduced at all? Does the application of silver salts induce an inflammation which, supplemented by infection, may endanger the sight? These are subdivisions of the major questions. The enactments and rules bearing on this topic are as follows:

By the Act of June 5, 1913, every physician practicing in any portion of the Commonwealth, who shall treat or examine any infant suffering with ophthalmia neonatorum (inflammation of the eyes of infants) shall make promptly a report to the health authorities upon blanks supplied for that purpose, giving such information relating to the case as the health authorities may require. That midwifes or nurses or other persons having the care of infants whose eyes have become inflamed or swollen within two weeks after birth, shall report the same in writing within six hours of the discovery thereof and shall make a similar report in writing to some regularly qualified practicing physician of the district. It shall be the duty of the health department, immediately upon the receipt of such report from other than a practicing physician, to notify the parent or guardian or other person having charge of the infant, of the danger to the eyes of said infant by reason of neglect of proper treatment of the same.

Every physician who shall treat any infant's eyes for ophthalmia neonatorum, shall within forty-eight hours after he ceases treatment, report to the Commissioner of Health stating he has ceased treatment and noting the condition of the infant's eyes at termination of treatment.

By the Act approved June 5, 1913, the Bureau of Medical Education and Licensure is authorized to formulate and issue such rules and regulations as may be needful for the proper conduct of the practice of midwifery by midwives.

In accordance with this authority, the rule has been promulgated that promptly after the birth of a child the midwife must cleanse its eyes with water which has been prevously boiled, and then drop from a dropper into each eye one drop of an one per cent solution of nitrate of silver. The eyes are to be washed immediately thereafter with boiled sterile water.

It will be noted that ophthalmia neonatorum is defined in the act as inflammation of the eyes of infants. The popular concept of an infant is that of a child less than two years of age; the legal concept carries the child to twenty-one years. Inflammation is a vague term and may be slight or severe, incident to a great variety of causes. It is obvious that, if this act were rigorously obeyed, reports, and quite useless ones, would be rendered by the tens of thousands. The term ophthalmia neonatorum is generally construed by the profession to mean a severe inflammation of the eyes, usually gonoccocal in nature. It is upon this basis that reports have been rendered.

Dr. Wilmer Batt, the state statistician, notes that in 1920 there were 97 cases of ophthalmia neonatorum reported; of these, but 27 developed in the first week of life, the others thereafter. Infections after the seventh day were obviously secondary and not acquired during birth. Of the cases which were, or possibly were, infected during birth, there were 3 in which laboratory examination confirmed the presence of the gonococcus. In none of these cases was there any permanent injury to the eyes.

These are the state records—inadequate, non-conclusive, but suggesting that crippling gonococcal inflammation of the eyes

is less common than in former years. This is inconsonance with practically all infections.

Dr. Martin, with the data as presented, thought that the Section could give an answer to the question, upon which could be based suggested future legislation in case it was believed to be needful.

Dr. G. E. de Schweinitz reviewed the various procedures for preventing ophthalmia neonatorum, namely, e ucation, compulsory notification, the punishment by law of offenders against properly constructed legal regulations, and compulsory prophylaxis. He datailed some investigations which the Commissioner of Health and he had made as to changes which might with advantage be incorporated in the present Pennsylvania law, and explained why they had concluded at that time, that except for making some of its provisions (early reporting, etc.) more stringent, they would advance no other suggestions. They had both decided that the subject, of great importance, should be subjected to further exact study, and therefore the Commissioner had come before the Opthhalmic Section in the hope he could obtain from its members expressions of belief which would be valuable in shaping additional legislation.

Expressing a personal opinion, Dr. de Schweinitz said the Crédé method (a 1 per cent solution of nitrate of silver preferred) continued to hold its place as a prophylactic; thus far it did not seem that a more effective substitute had been devised. It was necessary in institution work and in the eyes of those children who pass through a birth-canal known to be infected, or from which the suspicion of infection cannot be eliminated prior to birth. But the practice of the method should be in the hands of those who are competent to use it, and he doubted the advisability of an unrestricted distribution of the silver prophylactic; he had seen too many severe reactions because of the ignorance of those who employed it to think otherwise, and therefore felt that compulsory Crédé prophylaxis and the free distribution of the silver prophylactic were subjects which required

additional study before a final decision should be reached, and tried to show how practically impossible it was to carry into effective operation a law of this kind. He detailed the advantages of compulsory notification, and quoted results in various states in support of this technic. He advocated the formation of a committee of oculists and of obstetricians whose duty should be, in consultation with the Commissioner of Health, to study the whole problem anew and to make recommendations with respect to legislation in this regard.

Dr. William R. Nicholson said there was no question as to the value of silver in the eyes of the newborn as a preventative of gonorrheal infection, if its use is expertly carried out. He was not convinced, however, that it was in any sense a preventative in every case, and unless used expertly it has little if any value, while it may have distinct possibilities for evil. During the first three years in which the midwives were under the control of the Bureau of Medical Education and Licensure of this State, the use of silver was not insisted upon and was practically not used. Since 1917, however, its use has been insisted upon and it has been used in all cases routinely. Since 1917, there have been delivered by the midwives of Philadelphia county, 33,726 babies, and the statistics which follow are based upon this number of cases, all of which have been inspected by the graduate physicians employed by the Bureau for this purpose. There had been reported 85 cases of ophthalmia neonatorum, showing a smear which was positive for the gonococcus, in which silver has been used in each case; also 14 cases of gonorrheal ophthalmia with positive smear in which no silver had been used. With 3 exceptions all the cases recovered without injury to the eyes. In the 3 above mentioned cases the reason for the failure was parental interference in two, while in the third, in which both eyes were lost, it was due to ignorance of the parents and neglect in reporting upon the part of the midwife. This midwife lost her license as a result of this negligence. A decided increase in the number of sore eyes of a non-specific nature has been found since the use of silver was insisted upon. Up to this time, however, there has

been no report of ill results from ophthalmia due to chemical irritation. Finally, there has been no decrease, but if anything a slight increase, in the number of cases of gonorrheal ophthalmia reported since the use of silver was insisted upon. All cases having sore eyes must be reported promptly by the midwife to the inspector who has her in charge, and every case is carefully followed until its cure has been attained. Dr. Nicholson believed that the report of all cases of ophthalmia neonatorum should be made promptly to the proper authority with the idea of insuring proper treatment to the newborn infant, and that there should be some definite punishment inflicted if such report is not made. If the use of silver is alone insisted upon—that is, without the inclusion of the reporting clause—little will be gained, based upon the experience which he had had among the midwives. He favored the use of silver in self-organized hospital services, and used it as a routine in his services at the Presbyterian, the Methodist and the Graduate School of Medicine of the University of Pennsylvania.

Dr. Barton Cooke Hirst said that the profession was fortunate in having at the head of the Health Department of Pennsylvania a man of Colonel Martin's sound judgment, large experience and practical commonsense to advise and direct lesgislation. Dr. Hirst believed that midwives, hospitals and dispensaries should be required to use the Crédé method, but that physicians in general should use their judgment in the individual case.

Dr. Louis Lehrfeld (by invitation) said that an analysis of cases reported to the Bureau of Health of Philadelphia shows that, while a large proportion of cases occur during the first three days after birth, a fair number occur during the first two weeks and rarely as long as one month. In 1919, there were reported 60 cases, 27 of which were positive for gonococcus, having an incubation period from one to thirteen days; in 1920, 82 cases, 35 with an incubation period from one to eleven days. These data were obtained by medical inspectors of the Health Department. Similar data obtained of cases in 1917, by a trained public-health nurse, showed an incubation period common during the first two

weeks and in one instance as long as one month. The large number of cases occurring after the third day has a direct bearing on the use of a prophylactic, indicating either that the medication used inhibited the growth of the gonococcus, or that the organisms were of low virulence, or that the prophylactic used was ineffective or insufficient. Dr. Lehrfeld believed that silver, as commonly used, is not a positive prophylactic for ophthalmia neonatorum. He felt that one instillation of one drop of any solution, silver or otherwise, gives a false sense of security and safety, and suggested that a bland antiseptic solution other than silver be used, and, instead of one drop, several drops should be instilled on three successive days. Summarizing the records of blindness throughout the country, there were 47 schools for the blind in 1920, with 4144 pupils, of whom 997, or 24.1 per cent, were blind from ophthalmia neonatorum. The admission rate from this disease was 26.6 per cent in 1907-08 in the schools, which rate decreased until 1917-18, when the rate was 14.7 per cent. This ratio increased in 1918-19, and in 1919-20 the admission rate was 23.2 per cent. These figures correspond with those from the Pennsylvania Institution for the Instruction of the Blind, where the percentage varied in different years from 8 to 50, and during the last thirty years averaged 26. He concluded that the blindness from ophthalmia neonatorum has not decreased in the proportions as ordinarily supposed.

Dr. J. Hiland Dewey said he desired to direct attention to the subject from a rather different angle. Practicing in New Jersey, where this law is in effect, he was frequently embarrassed by threats of lawsuits against doctors who have not used the drops at the time of birth. The public is soon educated to the fact that the drops are required by law. The infants are brought to you, and no matter what the cause of the sore eyes may be it is ascribed by the parent to the omission of the drops. Recently I saw a child, three weeks old, with congenital dacryocystitis, and the mother threatened a lawsuit against the physician who attended her for neglecting to use the drops.

Dr. T. B. Holloway referred to the number of cases that had

been officially reported to the State Health Department, and felt that these were considerably less than the number of cases that had probably developed in the state. He alluded to the estimate he had made some years ago in the study of this subject. He stated that in the two schools for the blind in this state 122 of the cases were the result of ophthalmia. The importance of the subject could be appreciated when it was realized that at the present time it costs over $600. a year to educate a blind child. Concerning some of the figures submitted in regard to the percentages in schools for the blind, he thought it ought to be stated that Dr. Lehrfeld had included statistics from the institutions operated in connection with the public school system in some cities. He was opposed to a compulsory law for the use of nitrate of silver for physicans and midwives, although he appreciated the importance of its use by proper hands, in proper institutions and in proper cases. What he objected to was the compulsory routine general use of the drug.

Dr. James Thorington said he was sorry that there had been any statement made which would reflect discredit upon the use of a 1 per cent solution of nitrate of silver in the sore eyes of new-born babies, as he did not feel that this silver solution, when properly employed, would produce an inflammation of the eyes resembling ophthalmia neonatorum.

Concerning Some Varieties of Toxic Amblyopia, with Illustrative Cases, being a Clinical Communication

Dr. G. E. de Schweinitz reviewed the clinical histories and results of treatment in four cases of toxic amblyopia, as follows:

Case I. *Quinin blindness, the examination having been made twenty-eight years after its onset.* At the time of examination the patient was a woman aged fifty-three years, who when she was twenty-five years old took "huge doses of quinin," given during the period of a complication following childbirth. "Total blindness" lasting one month supervened, followed by gradual restor-

ation of vision. At the time of Dr. de Schweinitz's examination direct vision was greatly restricted for white and colors, and followed the types first described by H. Knapp in that they were somewhat oval in shape, the long axis being horizontal. There was marked reduction of light-sense (less than 1/10 with de Wecker's photometric types). The disks were paper-white, the vessels reduced to threads, and there was distinct arterial perivasculitis.

Dr. de Schweinitz referred to other cases of blindness from this cause, when the examination had been made years after the onset of amaurosis, in one case thirty-five years; to the vascular changes which he had noted experimentally, and which had been described by a number of authors in the human subject; and to the inconvenience which reduction of light-sense, usually permanent, caused, occasionally resulting in a psychasthenic state with serious consequences.

Case II. *Amblyopia in a Dye Worker.* The patient, aged fifty-six years, began ten months prior to his examination to note failing vision, which increased. He had stopped smoking and the use of alcohol. Both disks showed the usual papillomacular area of atrophy; there were large central color scotomas; vision O. D., 5/30; O. S., 3/60. As long as he remained at his occupation treatment had been unavailing. Gradually, after stopping his work and under the influence of alteratives, strychnia, diaphoresis and negative galvanism, improvement began. After seven months of this treatment, vision rose practically to the normal standard, 6/9, and the scotomas disappeared, save only for a slight deficiency of color perception directly over the fixing point. While at work the patient was constantly in contact with anilin dyes (red and blue), and with bisulphid of carbon; he also used much sulphuric acid and caustic soda, sulphid of sodium and hydrochloric acid. The patient attributed his trouble to the "noxious fumes" he frequently inhaled.

Dr. de Schweinitz discussed the subject somewhat from the clinical standpoint, with the help of Dr. George Meeker; but as no opportunity for chemical examination of the substances referred to had been possible, this discussion was largely speculative.

While it was not proved that this amblyopia was definitely due to these chemicals or their products, Dr. de Schweinitz after very careful examination could find no other cause, and he thought it likely that the case belonged to the group of amblyopias which are attributed to bisulphid of carbon, which had years ago been so elaborately investigated in England.

Case III. *Toxic Amblyopia (Tobacco-Alcohol Amblyopia); Relation of Intestinal Stasis to the Visual Field Defects.* The patient, a man aged sixty years, had used alcohol and tobacco excessively, and had a clear history of long-standing intestinal disturbance; also of gastric ulcer. Vision, O. D., 6/100; O. S., 6/60; typical scotomas and pallor of the disks. Treatment of various kinds, including a course at the Hot Springs, had been followed by slight improvement (the patient probably abstaining from his bad habits for a time), but he had relapsed and vision continued to fail. At the time of examination the patient's breath was exceedingly unpleasant, its odor being like that noted in diabetes, but there was no glycosuria, and medical examination revealed notable intestinal stasis, the colon being literally packed with hardened feces. Restoration of the normal intestinal functions and strict abstinence from tobacco and alcohol resulted in three and one-half months in a return of normal vision and disappearance of the scotoma, a condition which obtains at the present time.

Dr. de Schweinitz discussed in connection with this case the views long ago expressed by Horner and Sachs, that intestinal toxins elaborated from gastrointestinal catarrh caused by the abuse of alcohol and tobacco bore a greater responsibility in creating these amblyopias than either the alcohol or tobacco itself. He emphasized the importance of treatment of the gastrointestinal tract in all cases of toxic amblyopia.

Case IV. *Failure of Vision Wrongly Attributed to Lenticular Changes, due to Toxic Amblyopia.* A man, aged seventy-one years, who in early life had lost one eye by virtue of an accident, but who had always maintained excellent sight in the remaining eye, began three years ago to note failure of vision, and, Dr. de

Schweinitz being absent at the time, he consulted a colleague who found a vision of 6/22 (previously it had been 6/6), a few striæ in the lens and slight perinuclear haze, to which the fall in visual acuity was naturally attributed. Three months later examination revealed a vision of only 5/150, but no increase in the lens changes, therefore quite out of proportion to the effects of such an incipient cataract formation. The man had all his adult life been a steady but not excessive smoker; he did not abuse alcohol. A careful perimetric examination revealed a large oval central scotoma for colors (red, blue and green). His tobacco was stopped, he was fully purged, and iodid of potassium and strychnia were exhibited. Very quickly improvement began, and at the expiration of two and one-half months vision had risen to 6/12, and he could read ordinary print with ease.

Discussing this case, Dr. de Schweinitz emphasized the importance of perimetric examination, especially of the central area of the field, in all cases of disturbed and failing vision, and also referred to the fact, which he had elsewhere recorded, that occasionally the onset of tobacco amblyopia is postponed until quite late in life, even when the subject, although a steady smoker, is not necessarily an excessive one.

Dr. de Schweinitz also referred to one patient, seen in consultation, on whom an excellent operation for cataract extraction had been performed by a colleague, resulting, however, in very poor vision. A large central scotoma was found, probably due to abuse of tobacco and perhaps alcohol. The patient had been lost sight of and more details could not be given. He also referred to a case of toxic amblyopia in a Chinese student in Dr. Howard's clinic in Peking, the loss of vision having followed soon after the patient had drunk freely of vinegar in which green peppers had been steeped. The rapidity with which the vision had failed suggested that the vinegar had been contaminated with methyl-alcohol, although as none of the decoction was available for analysis this could not be proved.

Persistence of Complete Hyaloid Vessels in Canal of Cloquet

Dr. Hunter W. Scarlett exhibited a girl, aged twenty-one years, with vision of light perception in right eye since birth. External examination, negative; left eye normal. Ophthalmoscopic examination with sph. + 16 D. lens showed a large grayish-white mass posterior to the lens and slightly to the temporal side. Proceeding from this mass was a stalk which extended back to and was attached to the disk. The size of this stalk was about that of the disk, and contained vessels filled with blood, which reached from the disk to the bulbous expansion in the anterior part of the vitreous. About two d.d. to the nasal side of the disk was a large, irregularly shaped, white mass with long projecting arms. This was traversed in places by vessels. Several areas of old choroiditis were distributed throughout the fundus.

Parsons describes a somewhat similar condition, as do also Collins and Mayon. Parsons quotes de Schweinitz and Randall as having reported a case some years ago, and gives in detail the various abnormalities that may exist as a result of the remains of vestiges of this structure and in conjunction with it, the most common being colobomas of iris, choroid, and disk.

Charles R. Heed M.D.,
Clerk.

PROCEEDINGS

OF THE

SECTION ON OTOLOGY AND LARYNGOLOGY

REPORT OF THE SECTION ON OTOLOGY AND LARYNGOLOGY

Officers of the Section elected were: Chairman—Dr. G. B. Wood. Clerk—Dr. N. P. Stauffer.

Members, 26. Meetings, 8. Average attendance—Members, $12\frac{1}{8}$. Average attendance—Guests, $66\frac{7}{8}$.

We have had a very large attendance at the meetings by the medical profession of Philadelphia, the most popular being the clinical nights with the Ophthalmological Section.

During the year we have entertained: Dr. D. C. B. Greene, of Boston, Dr. J. V. Klauder, Dr. George E. Pfahler, Dr. T. H. Weisenburg, Dr. Wendell C. Phillips, of New York.

List of Papers

The programs were as follows:

January 19, 1921

Resolutions offered on the death of Dr. Freeman.

Buffet supper at Rittenhouse Hotel in honor of Dr. Greene, of Boston.

Dr. D. C. B. Greene spoke on "Carcinoma of the Upper Jaw, its Treatment by Radiation and Operation."

February 19, 1921

Dr. J. V. Klauder (by invitation) gave a lantern demonstration and talk on "Syphilis of the Mouth and Throat, Clinical Manifestations."

March 16, 1921

Dr. George E. Pfahler read a paper connected with "Several New Positions for Diagnosing Sphenoidal and Accessory Sinus Diseases by the X-ray." Dr. T. H. Weisenburg spoke on "A Consideration of the Vestibular Apparatus."

April 27, 1921

Clinical Night at the Jefferson Hospital.

Dr. Chevalier Jackson: "Exhibition of Laryngeal and Esophageal Cases."

Dr. S. MacCuen Smith: "Radical Mastoid."

Dr. Nathan P. Stauffer: "Frontal Sinus Operation (Modified Killian)."

Dr. George Fetterolf: "Submucous Resection."

Dr. Warren B. Davis: "Tonsillectomy, Application of Suture Ligatures."

Dr. George B. Wood: "Maxillary Antrum Operation (Denker)."

Dr. Fielding O. Lewis and Dr. W. T. Annon (by invitation): "Bouginage Laryngeal Stenosis."

Dr. Curtis C. Eves: "Tonsillectomy by Dissection, Local Anesthesia."

Dr. Ralph Butler: "Tonsillectomy by the Sluder Method."

Dr. R. Ridpath: "Tonsillectomy by the La Force Method (Local Anesthesia)."

Dr. Benjamin Parrish: "Tonsillectomy by the La Force Method (General Anesthesia)."

Dr. Samuel S. Woody, Chief of the Municipal Hospital: "Demonstration of Intubation and Extubation."

May 18, 1921

Dr. Wood showed a patient who had an operation for round-celled sarcoma in the right tonsillar space involving the anterior pillar and sheath.

Dr. F. O. Lewis showed a patient who had a traumatic laceration of the nose with compound fracture and protrusion of the nasal mucous membrane through an external nasal wound. Wound has been sutured. Also a patient with a sarcoma involving the left pharyngeal wall and the larynx. Also a patient, aged ten years, with a "Modified Killian Operation."

October 19, 1921

Dr. Chevalier Jackson gave a very instructive and interesting talk on "Tracheotomy," with drawings and lantern slides and exhibition of patients.

November 16, 1921

Dr. Wendell C. Phillips, of New York, gave a talk on "Comments on Atypical Cases of Mastoid Involvement, with Suggestions as to Treatment." He also gave a film demonstration of the mastoid operation.

Dr. S. MacCuen Smith gave a paper on "Indications for Simple Mastoid Operation."

December 21, 1921

Dr. C. B. Wood, "Tonsillectomy, General Anesthesia."
Dr. C. C. Eves, "Tonsillectomy, Local Anesthesia."
Dr. F. O. Lewis, "Tonsillectomy, Complications."
Dr. George Fetterolf, "Tonsillectomy, Sequela."

Dr. N. P. Stauffer,
Clerk.

PROCEEDINGS

OF THE

SECTION ON GENERAL MEDICINE

OCTOBER 24

Relation of Aleukemic Leukemia, So-called Pseudoleukemia and Malignant Granuloma. (Abstract.)

BY HERBERT FOX, M.D., AND DAVID L. FARLEY, M.D.

Two cases of aleukemic leukemia and one case of lymphosarcoma, similar in some degree in clinical course and physical appearance and their distinction from lymphogranuloma, are reported.

Attention is called to the need for classification of the enlargements of lymphatic bodies and the hyperplasias of these and allied tissues in the absence of a definite increase in the circulating leukocytes.

The term "pseudoleukemia" has outlived its usefulness as a noun and should be used in an adjectival sense only.

Aleukemic leukemia is a systemic lymph-tissue disease, in pathology essentially like typical leukemia but without increased circulating leukocytes. Leukemic phases may occur in its course or just antemortem.

A generalized lymphadenopathy is more suggestive of leukemia than of lymphogranuloma and tumors.

The two cases of aleukemic leukemia reported, while showing very extensive involvement of the lymphatic apparatus, gave

no reduction of circulating mononuclears, a relative reduction being a picture usually seen in granulomata and sarcomata involving much of the lymphatic apparatus. This point should be a decided help in clinical differential diagnosis.

Aleukemic leukemia is widely separated from cellular Hodgkin's disease in its histology by the absence of inflammatory changes in the former and their presence in the latter; leukemic processes are definitely more uniform or homogeneous than granulomatous.

An excision of a lymph node for microscopic study is the only reliable method of making a decision as to diagnosis in lymphatic enlargements. It is valuable also from the standpoint of prognosis and treatment.

Mention is made of a difference in the response to *x*-ray of the leukemic and the granuloma groups as seen in the affected lymph node. This will be taken up in a later communication.

An attempt at the production of an antigen for specific protein skin tests in the lymphatic diseases resulted negatively.

This article will be published in complete form in *The American Journal of the Medical Sciences*, 1921.

DISCUSSION ON THE PAPER OF DRS. FOX AND FARLEY

Dr. H. A. Hare: I should like to ask whether the authors of the paper wish to have us believe that their somewhat dogmatic advice to excise a gland for diagnostic purposes is meant by them to include all enlarged glands in the neck or elsewhere, because I believe it is now generally considered that such excisions are very prone to result in further metastasis, and it seems to me that even if they wish to limit their advice to the particular conditions which they have described in their paper, that the very thought of making an excision shows that there is a possibility of the glandular enlargement belonging to another class of growths.

I should also like to ask why it was thought best to excise a gland near the clavicle. I should have supposed that the higher up the excision was made the safer it would be.

Dr. David Riesman: The paper we have just heard is a valuable contribution to one of the most obscure subjects in internal medicine.

I should like to have Dr. Farley's opinion upon a case that recently came under my observation: A young man, aged about twenty-two years, had enlargement of the glands of the neck and of the axilla. An x-ray examination showed that the mediastinal glands were likewise enlarged. The affected superficial glands were small, firm and discrete. There was no fever, no impairment in health, a practically normal blood count and a negative Wassermann test. There was no enlargement of the spleen. The case reminded me very much of one I saw a number of years ago in which the enlargement was due to tuberculosis of the glands. At my suggestion Dr. Alleman, of Lancaster, the family physician, excised one of the glands. Sections were made by one of our ablest pathologists, who reported that it was probably a tumor. On submitting the slides to two other pathologists their report was tuberculosis. The patient has done so well under the x-ray and heliotherapy that it will be difficult to get another gland from him for animal inoculation. Until that is done, and it proves to be positive, the diagnosis of tuberculosis cannot be considered established.

Dr. Solomon Solis-Cohen: I have seen a number of enlarged cervical and other glands with blood changes in which diagnosis was difficult, and some which have not yet been definitely diagnosticated, notwithstanding careful adenectomy by surgeons and careful study by the pathologist. I should like to know whether in the cases reported, or in any other case which the authors may have seen, x-ray studies of the lungs and thorax have been made.

In three such cases carefully studied with one of my staff at Jefferson Hospital, Dr. Kramer, the cases having been seen at Blockley or at Jefferson, we found what looked like a lymphatic involvement of the lungs, not tuberculous and of a peculiar nature, which we hope to describe later. There has been no occasion for autopsy, so we cannot report accurately.

Another case, a young man, was admitted with enlarged glands of the neck, axillæ and groins, together with cough, hemoptysis and dyspnea. He had been sent in with a diagnosis of tuberculosis. The man was weak and emaciated. The heart was feeble. Examination of the blood showed nothing except a slight lack of hemoglobin, a slight reduction of red cells and a slight excess of polynuclears. The case seemed to me to be sarcoma rather than tuberculosis, the physical signs of consolidation being widely distributed and greatest in the middle of the left side of the chest. At this particular hospital the roentgenologist reported conclusions instead of descriptions, and in this case his report was pulmonary tuberculosis. Not being satisfied therewith I made a

study of the plate with Dr. Kramer. We found a large irregularly quadrilateral shadow from the root of the lung upward into the middle of the upper lobe of the left lung, and scattered shadows more or less dense throughout the lung, and we retained our diagnosis of sarcoma, which was confirmed at autopsy and by histological study.

I believe there are more mistakes made in the diagnosis, outside of hospitals and sometimes inside, on the side of tuberculosis than on the side of Hodgkin's disease or sarcoma.

I should like to ask Dr. Fox and Dr. Farley whether in their cases there was any notable reduction of red cells or hemoglobin or any pathological change in morphology of the red cells. There was none such in any of the three cases referred to in the opening of these remarks.

Dr. Herbert Fox: I might say that this is one of the groups of cases which we have come across in the University Hospital and Pepper Laboratory, and it exemplifies the need for exact classification and diagnosis. Too often an aleukemic patient with a lump in the neck is called Hodgkin's disease and allowed to go at that, but experience and roentgenology show that the difference between the *x*-ray reaction of aleukemic leukemia and Hodgkin's disease demands explanation. Exact diagnoses are the only ones that can be used in spacing and dosage of *x*-rays. Diagnostic adenectomy seems the only exact method of establishing the nature of a lymphatic growth. Two of these cases were diagnosed as Hodgkin's disease until the gland was cut open.

The selection of the gland is a matter of some importance. If, as in the case of typical Hodgkin's disease of the Reed type, the most of the glands in the neck are in a mass, and one of moderate consistency on the edge of the group can be shelled out, it should be done. The major mass should not be incised. If the glands be of the same consistency it will make small difference which gland is selected, but it is well to select, if possible, one away from a drainage area. If the glands be of variable consistency, some hard and some soft, one of moderate consistency should be selected for the following reason: Soft glands are cellular and hard glands are fibrous; a gland of medium consistency will contain both elements in distinctive proportions.

Replying to Dr. Hare: Incision into a tumor or mass is inadvisable; when such exists a gland in its immediate vicinity should be selected or one shelled out from the mass. Glands should be removed with their capsule. When it is possible to take a gland away from a drainage region, above the clavicle instead of the sternocleidomastoid region, this should be done, since in such a choice one will not be confused by a possible chronic inflammatory process in addition to the lymphatic hyperplasia.

In reply to the question of the advisability or necessity of removing glands in all lymphadenopathies, I would say that there are typical cases of tuberculosis, Hodgkin's disease and leukemia from which no gland need be removed. But in the borderline cases, for which we hope to be able to establish a stable x-ray therapy, this is today the most direct and exact diagnostic measure.

Dr. Farley: Dr. Riesman has raised the question of tuberculosis of lymph nodes simulating Hodgkin's disease. Recently we have had two cases in which the clinical diagnosis before death was Hodgkin's disease. Examination of an excised node in one case showed non-caseous tuberculosis. The other case was classified by bioscopical study as an atypical Hodgkin's disease. Postmortem, however, showed a generalized miliary tuberculosis, also massive areas of tuberculosis of the spleen, yet certain areas were clear and showed a histological picture very close to that of Hodgkin's disease. With all the clinical and postmortem data we are still unable to decide whether the case was Hodgkin's disease with a secondary tubercular condition or purely tuberculosis of the non-caseous type.

Sternberg, in 1898, reported a series of thirteen cases of Hodgkin's disease, from eight of which cases he had isolated typical tubercle bacilli. His decision at that time was that tubercle bacilli of low virulence are the cause of Hodgkin's disease, and there are still men today who defend that stand. There is no doubt that in Hodgkin's disease tuberculosis is a frequent secondary affection.

The Effects of Quinidin Therapy in Auricular Fibrillation

BY C. C. WOLFERTH, M.D.

Experimental studies of the action of quinidin on the heart have shown that the drug depresses the functions of contractility, excitability and conductivity. The evidence as to the influence on stimulus production is not decisive.

Quinidin exerts a remarkable effect on clinical auricular fibrillation and flutter. Out of 151 cases collected from the literature the normal rhythm was restored in 76. Of 12 cases

studied in the University Hospital the normal rhythm was restored in 7 and fibrillation converted to flutter in 1. But in only 3 of the cases could the clinical results be classed as successful. The others reverted to fibrillation too soon for any real improvement to occur. Two patients have now retained the normal rhythm for at least three months.

Quinidin does not seem to improve cardiac function, but in some cases distinctly makes it worse. Whatever benefit is derived from the treatment of flutter and fibrillation is due to the removal of the mechanical disadvantage to the heart of an abnormal mechanism. This is demonstrated by the failure of these patients to improve in whom fibrillation is not abolished.

The use of the drug is not without danger. Two deaths have been reported in addition to a number of cases in which alarming symptoms developed. In this series no untoward symptoms were observed during the treatment.

The best results are obtained in patients whose compensation is good and who have had fibrillation only a short time. Severe decompensation is a contraindication to the use of the drug.

Quinidin sulphate is used in preference to the pure alkaloid because of its greater solubility. One or two small preliminary doses should be given to test for hypersusceptibility. The dosage varies from 0.4 to 1.0 gram t. i. d. It is better to begin with the smallar dose and gradually increase until the normal rhythm is restored, but if the treatment is not successful in ten days it should be discontinued and repeated later. The development of untoward symptoms demands immediate withdrawal of the quinidin treatment.

DISCUSSION

Dr. H. A. Hare: I am very glad that Dr. Wolferth has emphasized the point that quinidin is notably a cardiac depressent in the sense that it diminishes contractility and therefore is probably a dangerous drug to employ in those cases of auricular fibrillation with decompensation. The point of interest, however, is to determine what Dr. Wolferth means by decompensation, or, in other words, how far can decompensation

increase before quinidin is contraindicated. There is no need to administer quinidin in auricular fibrillation—or, for that matter, any other drug—if there is no decompensation. Sir James MacKenzie has repeatedly pointed out this fact, and added that if the ventricular beat is 90 or below and the compensation efficient, active treatment is not necessary. It is also of interest to note that the action of quinidin and digitalis is quite different, although both of them seem to control auricular fibrillation better than anything else. Digitalis increases contractility and quinidin diminishes it. Digitalis, at least in part, depends for its beneficial effects upon its stimulation of the vagi; quinidin has no such effect. Both of them, however, act apparently by diminishing the conductivity of the atrioventricular bundle.

I wish to congratulate Dr. Wolferth upon his clear description of this interesting subject.

Dr. Joseph Sailer: It is to be hoped that we are finally approaching a satisfactory system of cardiac therapeutics. When we look back over the past history of digitalis and other drugs supposed to influence the heart, we recall that digitalis was used in certain valvular diseases and not used in others without any particular reason therefor excepting theoretical consideration on the part of the physician.

We must realize one thing, and that is that auricular fibrillation does not necessarily seriously strain the heart. Dr. J. H. Musser, Jr., reported from the Presbyterian Hospital a case that he found had auricular fibrillation and that for the past twenty-six years had at various times been admitted to the hospital, and each time it was noted that the heart was extremely irregular.

I have under my care a very active, energetic lady who has had auricular fibrillation for at least seven years, and apparently suffers little, if any, from her cardiac condition.

I am wondering if a case of this kind should be given quinidin. As the patient has no decompensation I have assumed that there was no indication for any drugs.

Dr. Wolferth: In regard to the point raised by Dr. Sailer, I should be inclined to agree with Dr. Hare and let well enough alone. If the patient has been fibrillating for a long time the expectation of restoring the normal rhythm is less than the average. If the fibrillation is without apparent ill-effects it does not seem worth while to run the risk of disturbing the patient's compensation by giving quinidin.

Dr. Musser asked about the effect of the drug in those patients in whom the normal rhythm was not restored. In one flutter developed, the

ventricular rate became very rapid, dyspnea ensued and the treatment was stopped on that account. In the others there was no conspicuous effect on the ventricular rate. In none were there untoward or alarming symptoms.

In regard to the point raised by Dr. Hare, as to the advisability of treating fibrillation without elevation of ventricular rate by digitalis, one's attitude will probably depend on whether he believes digitalis as given clinically is an aid to cardiac contraction. If the cases show symptoms it would seem worth while to try the effect of digitalis.

In my paper I used the term decompensation in its ordinary sense, *i. e.*, the persistence of symptoms of cardiac inadequacy after the patient has been put at rest.

I wish to reëmphasize the warning against giving quinidin to decompensated patients. Quinidin is a cardiac depressant, and if one does not have a comfortable margin of cardiac reserve to work on the depression of the heart's action may cause a serious situation. The drug is in the experimental stage. If it is to be given the patient should be under constant observation. This can be done best in a hospital. If unfavorable symptoms develop the drug should be stopped immediately. Two deaths have been reported from Germany. The treatment should not be undertaken with patients coming to out-patient clinics or to offices.

The chief importance of quinidin is that it has shown the possibility of influencing aberrant paths of the excitation wave in a manner beyond what had been thought possible. It has therefore opened a new field for research from which there may possibly be obtained a new drug or methods of treatment that will enable us to restore the normal mechanism without the element of risk attached to the present method.

Medical Practice and Customs in Siam

BY A. G. ELLIS, M.D.

Siam is an absolute monarchy. The king, most of the princes and many officials have European education but most of the subjects are illiterate. The result is that most of Siam's activities, including medicine, are a strange combination of ancient and modern ideas and methods.

For the common people medicine is largely superstition ad-

ministered by herb doctors, fakirs, illy-trained midwives and poorly-taught physicians. There are no laws as to medicine, and anyone who chooses may practice. In Bangkok are a number of foreign physicians and Siamese who have received their medical education in Europe. The higher classes employ these, often changing every day or two if immediate relief be not obtained. The remainder of the country is without real medical aid except as supplied by the dozen American missionary hospitals or the army physicians in certain locations. Private practice as we have it is hardly possible there; each Siamese physician that practices in Bangkok has a dispensary (drug store).

A public health department for the interior was started a few years ago, but is being organized slowly in the face of two great difficulties: (1) The lack of properly trained physicians to man it, and (2) the apathy and even active opposition of the people toward hygienic and sanitary advances. This is largely a question of climate and mode of living, as Siam is a tropical country, Bangkok being about one degree south of Manila.

There is one medical school in Siam, the medical department of the Royal Chulalongkorn University at Bangkok. It has 100 students. A six-year course is divided into four years at the university and two years in its hospital. Because of lack of teachers and equipment the preclinical branches are either entirely neglected or illy taught; an appeal has recently been made to the Rockefeller Foundation for aid, especially in these branches.

Bangkok has several hospitals. The Chulalongkorn, a memorial to the late king, is a thoroughly modern pavilion hospital of 140 beds, one of the finest hospitals in the Far East. New buildings are continually being added. Near it is now being erected an imposing Pasteur Institute, a Red Cross memorial to the late queen. The Siriraj Hospital of 150 beds, the hospital of the medical school, is old and poorly equipped, but a new one is now largely financed. Both these hospitals have training schools for nurses, but they are very inefficiently managed. Midwifery is taught to all nurses and most graduates practice it as a profession.

Indications are that the near future will see the actual beginning

of real medicine in Siam. The officials are awaking to the needs of medical education and practice. An increasing number of students are going to Europe and America. The need of public health work is being recognized and a real program for building new medical institutions is under way.

Some Experiences in the Practice of Medicine in the City of Canton, China

BY WILLIAM W. CADBURY, M.D.

CANTON CHRISTIAN COLLEGE AND CANTON HOSPITAL, CANTON, CHINA

The Canton Hospital was opened November 4, 1835, by Dr. Peter Parker, after he had journeyed for 140 days from New York. He was the first medical missionary to be appointed, and thus may be said to have inaugurated this phase of missionary work. The first amputation was performed after a bribe of fifty dollars had been given to the patient.

Dr. Parker was a graduate of Yale University. His successor, John G. Kerr, served the hospital for forty years and did more than anyone to introduce the science of medicine to the Chinese. He was a graduate of Jefferson Medical College of this city. He in turn was followed by Dr. John M. Swan, who remained at the hospital for a period of twenty-nine years.

The present staff of the hospital consists of three surgeons, two eye, ear, nose and throat men, one internist and a roentgenologist, just appointed.

During the past ten years there have been 20,000 patients admitted to the wards and 14,000 operations performed on in-patients. In the province of Kwangtung, of which Canton is the capital, there is only one hospital bed to 10,000 persons.

A few unusual features in the practice of internal medicine in the city of Canton have been gleaned from twelve years' experience, more than half of the time as a member of the staff of the Canton Hospital.

Unlike most inhabitants of the tropics the Cantonese are very energetic, industrious and the most progressive of all the Chinese. In the Cantonese dialect the final consonants are not dropped, as is so generally the case with peoples who have migrated into tropical regions from the temperate zone.

The average blood-pressure of the people is low. For healthy athletic young men at the Canton Christian College the systolic pressure averaged from 94 to 104 mm.; the diastolic from 57 to 73 mm.; the pulse-pressure from 27 to 42 mm.

Chronic nephritis of the parenchymatous type is common, but the variety generally called chronic interstitial with associated high blood-pressure, polyuria, scanty albumin and a tendency to uremic coma is extremely rare. In 1919 and in 1920, out of a total of 65 cases of nephritis, there was not a case with elevated blood-pressure.

Pulmonary tuberculosis is everywhere very prevalent, as might be expected from the unsanitary conditions in which men live. Tuberculosis of the bones, joints, glands and the peritoneum are very common among the young. This cannot be of bovine origin, for beef, milk, butter and cheese are rarely eaten by the Chinese people. In this connection it is very remarkable also that rickets is such an exceedingly rare disease. In twelve years of practice I have seen but a single case among the Chinese, and my medical friends of South China report a similar experience. The food of infants, after they are weaned, consists for the most part of rice, with a little green vegetable and occasionally a small portion of pork or fish.

While the Chinese generally partake of light rice wines and sometimes drink 40 per cent spirits made from rice, drunkenness is almost never observed on the streets or in the restaurants. In five years there were but three cases of acute alcoholism admitted to the medical service of the hospital.

Acute appendicitis is rarely seen and the chronic form is by no means common. During the last seven years at the hospital, out of 7482 general operations, many of them laparotomies, there were but 18 operations for appendicitis.

Typhoid fever, though present, is not as prevalent as might be expected in a community where almost nothing is known of the laws of sanitation. Last year there were about 900 in-patients in the medical service of the hospital, and only 32 of these were diagnosticated as typhoid fever.

Scarlet fever is never seen in Canton, though it has appeared in Hongkong, and is often quite severe in Central and North China.

Syphilis is common among the soldiers and the civilian population of the cities. It is rare in the country villages. It has been noted that paresis and tabes dorsalis are rare complications among the Chinese. They are not infrequent in Canton, however, and it has been suggested that where the infection was acquired through contact with foreigners, as in the case of port towns, these complications are more common than in the interior cities.

Lepers walk the streets of the city, although an attempt is made at segregation. At the Canton Hospital I hold a weekly leper class at which the patients are given injections of the chaulmoogra oil and its derivatives.

Beriberi is one of the commonest diseases at our hospital, especially among the soldiers. Malaria of the tertian variety is also common.

In general, with the exceptions noted above, the type of cases received into the medical wards of the Canton Hospital closely parallels that in the large general hospitals of American cities.

NOVEMBER 28

The Utilization of Laboratory Methods. (Abstract.)

BY SYDNEY R. MILLER, M.D.
BALTIMORE, MD.

I. Introduction. New viewpoints, hypotheses and methods tend to determine eras in medical progress. The science of

medicine in recent years has been characterized by a somewhat excessive stressing of functional diagnosis, arrived at, for the most part, by the utilization of laboratory procedures. This has logically been associated with the development of:

(*a*) The introduction of many mechanical devices and instruments of so-called precision.

(*b*) The elaboration of an enormous number of laboratory tests.

(*c*) The gradual subdivision of medicine into specialties.

All this is evidence of a merited attempt to reduce medicine to a pure science, thus to render the diagnosis of disease easier and more accurate, and hence to establish therapy upon more specific and rational grounds.

Certain undesirable and unavoidable consequences have resulted, among which might be mentioned:

1. Clinical investigation has gone more and more away from the man engaged in clinical practice into the hands of laboratory workers, most of whom have but a limited view of the problems which daily beset the clinical practitioner of medicine.

2. There has been an unintentional neglect of many of the fundamental branches of medicine.

3. Confusion has been created throughout the profession, particularly among the practitioners, as to the value and interpretation of many laboratory procedures.

II. *The Variety and Grouping of Laboratory Procedures.* The elaboration of many and diverse laboratory methods, proven, presumed or anticipated to be of diagnostic utility, makes necessary a sharp discrimination or classification of them. One grouping is as follows:

(*a*) *Research Laboratory Methods.* Under this might be included those procedures pursued by reason of the expectation that they would advance the science of medicine. Many of these emanate from research laboratories which may or may not be associated with clinical hospitals. They often deal with subjects which at first glance have but an indirect relation to some unsolved phase of medicine. Their execution frequently involves the use of

complicated apparatus and the application of a special technic beset with many possible sources of error. Their utilization should be confined to well-organized medical clinics and the results there obtained subjected to long and critical analysis before the text can have assigned to it a correct value. One might cite as examples:

1. Basal metabolism.
2. Many phases of blood chemistry.
3. Complex serologic or immunity reactions.

(*b*) *Laboratory Methods of Demonstrated Clinical Utility.* Under this heading are included those tests which have been demonstrated to possess relative values. They frequently have been the result of original research investigation, subsequently amplified and simplified, so as to possess ease and safety in clinical application, expediency and ready interpretation. Sources of error, either in their conduct or interpretation, are common to all. All demand an assessment of their value by one properly trained to do so.

(*c*) *Laboratory Methods Which Alone Are Diagnostic of a Disease Entity.* In this group the number is surprisingly few. An attempt to classify those under such headings as blood, sputum, urine and so forth is worth anyone's attempt both for the information it will give and the caution it should induce. Suffice it to say a diagnosis is rarely established on laboratory evidence alone and but few tests throw truly comprehensive light on the entire situation.

III. *The Dangers Arising from Improper Utilization of Laboratory Tests.* Improper utilization of laboratory methods is distressingly widespread. Many factors have brought this about. These, in brief, might be summarized as follows:

(*a*) Incorrect diagnoses based on laboratory work improperly done.

(*b*) Incorrect diagnoses based on laboratory studies correctly done but wrongly interpreted.

(*c*) Premature reliance on tests of uncertain value.

(*d*) Reliance on laboratory data to the exclusion of others.

(*e*) The seizing upon of positive findings as diagnostic with a resultant disregard of or failure to observe other findings of equal or even greater importance.

(*f*) Failure to confirm or amplify tests reported in a way inconsistent with the clinical findings.

(*g*) Failure to utilize laboratory methods at all.

These difficulties in the way of a correct utilization of laboratory methods have resulted in the creation of some very real dangers:

(*A*) *Dangers to Medical Students.* Medical students are either given or at least acquire the impression that laboratory methods outrank the simpler and less spectacular ones. Clinical medicine is liable to become to him an illogic division of the body into parts. He fails to secure a proper correlating frame of mind and acquires an oblique view of the duties and responsibilities he is about to assume.

(*B*) *Dangers to Practitioners.* Graduates of recent years are liable to feel inadequately equipped to practice medicine without extensive offices, expensive laboratories and mechanical devices. Older practitioners in an endeavor to keep abreast of the times install apparatus or install technicians to carry out procedures, imperfectly understood if at all by the doctor. With increased overhead expense the need or temptation to charge increasingly large fees follows, or they have recourse to many commercial laboratories in far too many of which poorly trained technicians mechanically turn out results uncontrolled. His art of observation becomes attenuated, curiosity fibrosed and inferential thinking supplants sound deductive reasoning. All of this creates:

(*C*) *Dangers for Patients.*

(*a*) Their conditions are incorrectly or incompletely diagnosticated. Despite this they—

(*b*) Are many times subjected to needless and oftentimes ill-afforded expense.

(*c*) Impersonally handled, not helped, by snapshot diagnoses, symptomatic therapy or insidious dogmas, they become naturally discouraged, come to regard the practice of medicine with skepti-

cism and become an easy prey to an ever-growing horde of enemies to medical science—charlatans, quacks and cults of fanaticism. Herein lies—

(*d*) *The Danger to Medical Progress.* Unless the knowledge now possessed by the medical profession be properly utilized the tremendous weight of popular opinion from an enlightened general public is not to be expected on our side. There is little justification for giving vent to outrageous indignation over existing conditions which may be called "commercialized parasitism" on human suffering, so long as the blame for its existence lies so squarely on our own shoulders.

IV. *The Solution.* This is relatively easy to point out but difficult to enforce. Of the laboratory worker must be demanded skill, accuracy, experience, honesty, a knowledge of medicine and a knowledge of the limitation of his own field of work. Of the internist, a knowledge of laboratory procedures, so that he may know what laboratory tests should be done; which are useless; and what interpretation to place upon the results which are given to him. To meet these two conditions greater team play is demanded if the proper correlation is to be expected. This, in turn, implies a greater indulgence in diligent reflective thinking, and traced back logically implies the need of more intensive teaching along lines of stricter logic and closer observation, if one hopes to combat the modern trend which favors an inertia atrophy of the emotion of wonder and instinct of curiosity. These, coupled with a broad humanitarian point of view, constitute the fundamentals for the advancement of medicine and its correct application to human disease.

DISCUSSION

Dr. E. B. Krumbhaar: I should like to say right at the start, as a laboratory man, I agree with Dr. Miller regarding the present misuse of the laboratory, and I should like to emphasize that the thing to do is for the clinician and the laboratory to work together. At the Philadelphia General Hospital we have tried to eliminate or minimize some of this difficulty largely by emphasizing the necessity for coöperation between the clinician and the laboratory worker. Laboratory workers

should more often be requested to come to the hospitals as consultants in seeing the patient, taking the pulse when the blood-pressure is too high and have an opportunity to study the treatment. This is not as common a request as for a surgeon to see a clinical case, and *vice versa*. There is no good reason why the clinician should not go more often to the laboratory than is being done in the hospitals I am acquainted with and see what is being done there at first hand.

Dr. James M. Anders: I have been much interested in the subject Dr. Miller has so well presented. I may say I began the practice of medicine when very few laboratory methods were utilized; apart from urine analysis there was practically nothing. This, I am sure, stimulated clinical observation and clinical diagnosis. Of course it is true there were cases which were not properly diagnosticated, but even since the advent of the new era, in which we have had a good many laboratory methods pointed out by Dr. Miller, we still continue to make errors in diagnoses.

The great thing, to my mind, is to maintain, if possible, a just balance between the older clinical methods and the laboratory tests of the new era. This has, unfortunately, not been carried out.

I have found, in connection with my hospital service, that very often routine examinations in hospitals are excessive; that they are very often carried to such an extreme as to be positively and distinctly wrong, as it works a hardship on the institution or patient which is unnecessary. In other words, we are working in charitable institutions, and it does not seem right to me to increase the cost of administration by useless and oft-repeated laboratory tests.

I believe in making a broad investigation in all cases as far as necessary, but these routine examinations in connection with perfectly obvious diseases must increase the cost of administration without being any help to the clinician.

On the other hand, in consultation, I have been convinced repeatedly that in smaller towns, in villages and in hamlets throughout the country generally the physicians have not been using laboratory methods to the extent they rightly deserve. I feel that too often a diagnosis is made from a single laboratory finding—that is, if albumin is found in the urine, without a doubt it is Bright's disease.

Similarly, examination of the sputum and finding the tubercle bacilli eliminates everything but tuberculosis of the lungs. It seems to me that the profession throughout the rural districts compares well with organized clinics. We are greatly in need of just such coöperation as Dr. Miller describes, and we should be working toward the day when an attempt shall be made to bring about a proper balance between the older clinical methods and the new-era laboratory tests.

Dr. Sailer: I believe thoroughly in the use of laboratory methods, but I think physicians are likely to depend on them too often. I also think there should be more coöperation between the laboratory man and the clinician. At the Pennsylvania Hospital the pathologist, Dr. Longcope, always went into the wards and saw the interesting cases, and Dr. Miller was saying that that is being encouraged in the institutions with which he is connected. Too many of the laboratories now are merely commercial, where the workers know nothing of the patients or cases under examination, and the report is often wrong, and in many cases they do not give the information that one seeks.

Dr. Landis: I have been very much interested in the idea of turning minds back to the more fundamental principles, particularly in the teaching of students. We have too much emphasized teaching the students the importance of laboratory diagnosis instead of teaching them how to use their senses. In cases of auricular fibrillation and other easily diagnosticated cases, why go to the expense of *x*-ray and laboratory examinations? I think there are many chest disorders which are easily diagnosticated without resorting to the roentgenologist and putting the patient to needless expense when there is no reason for doing so. I have seen the *x*-ray used on cases showing advanced lesions, and I do not think it should have been necessary to *x*-ray for diagnosis, costing the hospital $2.50 or $3.

I think we should impress upon the student the necessity of really learning the fundamentals, and I agree with Dr. Miller that when there is a doubt in making a diagnosis then it is well to resort to laboratory methods; but if one has a perfectly obvious diagnosis in front of him, why go to further means to clinch it? If one has a typical case of tuberculosis, why submit the patient to various tuberculin tests?

Dr. Burr: I am very glad to hear Dr. Miller, and I agree with him, through and through, that the young doctor of today leaves the medical school with the idea that diagnosis is to be made by laboratory apparatus. I ask my intern, when a patient has come in, what is the matter, and I am told that either he has or has not a positive Wassermann. It makes no difference whether he is paralyzed or what is wrong, he has a positive Wassermann. I go into a ward and see a man with a flushed face, dry skin and dry lips, and I ask the intern what his temperature is, and he says, "Doctor, my thermometer is upstairs." A man comes in who has evidently had a hemorrhage from somewhere or other, and when asked the intern's reply is, "Doctor, we have not examined his stool with a microscope." It had never entered his head to look at the stool himself but sent it to be examined with the microscope.

Now, gentlemen, these things are not the lack of intelligence in the medical student but are due to the system of education, and I can best show what I mean by a little story in my own life, more years ago than I care to remember: Dr. John Ashhurst cut a tumor out of a man, and when he had taken it up and shown it to us he cut across it with a knife, felt of the cut surface and said, "Gentlemen, this is a sarcoma." Twenty-five years after that I happened to be in a clinic where the surgeon was doing precisely the same operation. He took the tumor off, threw it into a basket and said, "Gentlemen, the laboratory will give us a report." Instead of using their own eyes, their own fingers and their own senses, they take the attitude that it is not their business to make a diagnosis, but some stranger by putting his eye to the microscope should do it. I have yet to see a graduate in medicine, within the last few years, who could tell whether a patient had a fever without the use of a thermometer; but this is a fact, and in every hospital there is too much dependence on laboratory methods. A man should be able to diagnose by his own senses.

I believe in laboratories and laboratory methods and all that sort of thing, but unless something is done to get back to the old teaching—that observation is the primary thing, and the laboratory is made the servant and not the master—when we get back to that we will get back to real medicine.

Dr. Miller: I do not wish to give the impression that I am a reactionary. I have always felt that whatever merit I possess in clinical methods I owe to Tom McCrae. The fury he would use upon a man if he did not use his eyes started a train of thought in my mind which I have never forgotten, and it helps me to understand why I am likely to do certain things and why the other fellow sometimes makes such foolish mistakes.

I am convinced that the fundamental answer rests, first of all, with ourselves. We do not subject ourselves enough to critical analyses, and very much depends upon getting the students started in the right way. The medical profession, not only in this generation but in others to come, will have to be taught fundamentals. We should go to the mountains of West Virginia or down into the swamps of South Carolina and see how well the practitioners do without the laboratory methods in the practice of medicine. They are doing as well as most of us nine times out of ten. They are using their eyes and their ears and their hands to aid them in their diagnoses. I think we could probably learn much from them, and it is also possible that we could give them something in return.

There is being started in Baltimore a plan to have medical missionaries sent out to desirable or desiring county medical societies to spend one, two, three or four days and give them all the help they can to enable them to become better practitioners.

The Introduction of Antimeningococcus Serum by Cistern Puncture: Report of a Case of Meningococcus Meningitis in an Infant of Four Months of Age Cured by this Method

BY A. GRAEME MITCHELL, M.D.

AND

J. J. REILLY, M.D.

As much as the employment of Flexner's serum has helped to reduce the mortality and lessen the number of sequelæ in meningococcus meningitis the death-rate is still high and residual injury occurs in a definite percentage of cases. Anyone who has witnessed such end-results of cerebrospinal infection as hydrocephalus, idiocy, paralysis, blindness and deafness will welcome any procedure which offers promise of lessening these consequences of infection in the ventricles and subarachnoid space.

There are several causes for the failure of serum treatment of meningococcus meningitis. Thus the particular strain of meningococcus acting as the infective organism in a given case may not be represented in the serum used; the virulence of the organism may be so great that the serum is of no avail; the serum may be given late in the course of the disease when the destructive processes already present would result in the death of the patient or in permanent brain injury, even though the causative organisms were destroyed. These sources of failure have been pointed out by Ayer.[1] It must be remembered that antimeningococcus serum operates chiefly as a bacteriolytic agent and must be brought into

[1] Arch. Neurol. and Psychiat., 1920, iv, 529.

contact with the organism it is intended to destroy. Herein lies the explanation of many failures of serum treatment.

It would seem, then, that there are three ways by which the treatment of meningococcus meningitis might be improved: (1) By making serum which will be as polyvalent as possible; (2) by administering serum early in the infection; (3) by so introducing serum that it will be brought into better contact with the causative organisms. In this connection it might be well to speak of the fact that serum may be given intravenously. Indeed, it has been claimed that almost 70 per cent of the cases of meningococcus meningitis show evidence of generalized infection and that the mortality can be greatly reduced by combining intravenous with intraspinal serum treatment.[1]

Our concern in this presentation is with the mode of introducing serum into the subarachnoid space. Heretofore there have been two points of entrance to the cerebrospinal system—between the lumbar vertebra and through the fontanelle into the ventricles. Except for rare accidents, lumbar puncture has been without danger and serum introduced by this route is curative in many cases. Subarachnoid block and the consequent failure to obtain fluid by lumbar puncture has been the indication for ventricular puncture. Ventricular puncture with the introduction of serum has increased the percentage of cures and also is apparently harmless if properly performed. After the closure of the fontanelle the ventricular point of attack is complicated by the fact that trephining is necessary. Some clinicians have gone so far as to recommend that ventricular puncture and the introduction of serum into the ventricles should be employed as a routine method in infants whenever the diagnosis of meningococcus meningitis is made.[2]

As has been stated the chief cause of failure when serum is given in the lumbar region of the spinal cord has been the inability, at times, to bring the serum into contact with all the infected surfaces of the subarachnoid space. It is in such cases—

[1] Hayden, R. L.: Arch. Int. Med., 1919, xxiv, 514.
[2] Caussade, L., and Remy, A.: Paris méd., 1921, xi, 129.

when the subarachnoid space is blocked by exudate whether in the spinal canal, the cisternæ, the foramina or over the convexity of the brain surface—that ventricular puncture has been indicated and that cistern puncture will also be found of use.

There are reasons why cistern puncture would be a method of choice if it could be shown that it is, if not devoid of danger, at least as safe as lumbar or ventricular puncture. (Ayer, after performing forty-three punctures in twenty cases, believes that it is a harmless procedure if carefully carried out.) The greatest amount of exudate in meningitis is often at the base of the brain in the cisternæ. It is from adhesions in this region that communicating hydrocephalus develops,[1] and it is probable also that the internal type of hydrocephalus may be caused by the spread of exudate and adhesions from the cisternæ into the foramina rather than from the ventricles into the foramina. By injection into the cisterna magna the serum, in concentrated form, is brought directly into contact with the most infected portion of the subarachnoid space, without the necessity of traversing the spinal canal or passing from the ventricles through the foramina and thence into the cisternæ. However, while cistern puncture should quickly gain widespread use as a method of treatment in subarachnoid block it will not be adopted as a regular route of approach in treating meningitis until its safety and efficacy have been further tested.[2] The technic as described by Ayer is as follows:

"The patient is placed on the side, as if for lumbar puncture, with the neck moderately flexed. Care is taken to maintain the alignment of the vertebral column to prevent scoliosis and torsion, and in cases in which comparative pressure readings are important the lumbar and cisterna needles should be on the same horizontal plane. After antiseptic preparation of the skin, usually including the shaving of a little hair and local anesthetization with procain, the thumb of the left hand is placed on the

[1] Blackfan, K. D.: Am. Jour. Dis. Children, 1919, xviii, 525. Taudy, W. E.: Johns Hopkins Hosp. Bull., 1921, xxxii, 67.

[2] See discussion of Dr. Ayer's paper: Arch. Neurol. and Psychiat., 1920, iv, 465–469.

spine of the axis and the needle inserted in the midline just above the thumb. The needle may be pushed rapidly through the skin, but should then be cautiously and guardedly forced forward and upward in line with the external auditory meatus and glabella until the dura is pierced.

"If the cisterna be entered at this angle there is usually a distance of from 2.5 to 3 cm. between the dura and the medulla, as shown on frozen sections; with the needle less oblique in position the distance between the walls of the cisterna becomes progressively less. Therefore it is good practice to aim a little higher than the auditory meatus, and if the needle strikes the occiput, to depress just enough to pass the dura at its uppermost attachment to the foramen magnum. At its entrance the same sudden 'give' is felt as in lumbar puncture.

"The needle employed is a regular lumbar puncture needle, nickeloid, 18 gauge preferred, with beveled stylet, sharp on the sides, but not too sharply pointed. There is rather less variation in the depth of the tissue traversed than in the lumbar region, being in an ordinary sized adult from 4 to 5 cm., the greatest distance in the series being 6 cm., and the smallest 3.5 cm. It was found that a faint circular scratch on the needle, 6 cm. from the tip, was entirely satisfactory in judging the distance, and was preferable to the deeper markings of the Patrick needle, which tend to make its insertion a little jerky and consequently less guarded."

In infants and children there are some slight modifications of this technic. Thus the distance from skin to cisterna is somewhat less—being about 2.25 to 3.5 cm.—depending on the age of the patient. A needle smaller than 18 gauge may be necessary at times, although a fairly large caliber needle is preferable to allow for the flow of thick and viscid cerebrospinal fluid. It has seemed to us that the "give" of the needle on entering the cisterna magna is greater than that which is experienced in successful lumbar puncture, and one should be cautious not to exert too much pressure lest the sudden entrance of the needle carry it too far in a forward direction.

While cistern puncture has been done on animals and for obtaining material at autopsy for some time, its use in the living human subject has been reported only by Ayer. It might be said in passing that the cistern has been drained after trephining at the base of the skull for the relief of meningitis.[1]

We wish to put on record our experience with cistern puncture in a case of meningococcus meningitis. Previous to the employment of cistern puncture in this case we had carried out the procedure on the cadaver with and without the skull-cap removed and also in several cases of tuberculous meningitis. In this latter condition the usual temporary relief of symptoms of increased intracranial pressure was noted exactly as would occur after lumbar puncture. Since treating the case of meningococcus meningitis we have used cistern puncture in a case of streptococcus meningitis and also in two cases of pneumococcus meningitis, but then only for diagnosis.

Case Report. J. B., Italian; male; aged four months; admitted to the Children's Hospital of Philadelphia, service of Dr. J. P. Crozer Griffith, on March 15, 1921. On admission the infant was partly breast-fed and partly artificially fed with a cows' milk mixture. Throughout the entire illness this combined feeding was continued.

History of Present Illness. For two weeks prior to admission the patient had been apparently in a febrile state, although the temperature had not been taken to verify this statement of the mother. The baby did not seem very ill until five days before admission, and the fever before this time may have been due to a left otitis media, which had been discharging at times for about six weeks. Three days before admission convulsions, described as generalized, began and these have recurred at frequent intervals since that time. The exact number of convulsions could not be determined, but they were evidently of frequent occurrence as well as of different grades of severity.

No history of other symptoms, in addition to those enumerated

[1] Haynes, I. S.: Arch. Pediat., 1913, xxx, 84.

above, could be elicited. There was no history of vomiting or of other gastrointestinal disturbance. The absence of vomiting is to be remarked, as it is one of the earliest and most constant symptoms of meningitis, being in our experience more frequent than convulsions.[1] The child seemed drowsy between the convulsive seizures but nursed from the breast and bottle fairly well. The mother was not intelligent enough to have noted such conditions as hyperesthesia or rigidity. The past medical history, including the details of the patient's birth, was uneventful, the patient having been born at full term by easy labor.

On admission the baby seemed quite sick. The temperature was 101° F., the pulse 150 and the respirations 48. Examination of the heart, lungs and abdomen revealed no abnormal findings. There was, however, marked retraction of the head as well as a positive Kernig sign in both legs and other signs of cerebrospinal irritation, such as increased knee-jerks, a positive Babinski reflex on both sides and a definite Brudzinski sign. A suggestive tache cérébrale was present. No ankle-clonus could be elicited. Pus was discharging from the left external auditory meatus. The pupils were equal and reacted slightly to light. The fontanelle was not bulging or tense—in fact, there was a slight depression in this region. Lumbar puncture performed at this time was unsuccessful, as fluid was not obtained.

March 16, 1921. On this date lumbar puncture resulted in obtaining only 2 cc of a very thick, yellowish fluid which showed the meningococcus in the stained smear, and later the organism was found on culture by Dr. A. G. Walz. After the removal of the fluid 1 cc of antimeningococcus serum was introduced with difficulty.

March 17. The first convulsive seizure since admission occurred on this date. By lumbar puncture 1.5 cc of thick pus were obtained. After irrigation of the spinal canal with physiologic sodium chloride solution, 1.5 cc of antimeningococcus serum were introduced.

March 18. During all this time the physical findings described

[1] Mitchell, A. G., and Falkener, W. W.: New York Med. Jour., 1918, cvii, 103.

on admission were present and the fontanelle remained depressed and under normal tension. Because of the evident subarachnoid block and the absence of a bulging fontanelle it was decided to do a cistern puncture rather than a ventricular puncture. A needle introduced after the manner described by Ayer at first failed to obtain fluid. A stylet was introduced into the needle. When the stylet was withdrawn it was followed by a long string of material resembling nothing so much as tenacious nasal mucus. Immediately after this a stream of turbid spinal fluid flowed from the needle under considerable pressure; 9 cc of this fluid were removed and 6 cc of antimeningoccocus serum were then slowly introduced. The specimen obtained by a cistern puncture showed that the meningococcus on the smear and the culture contained albumin and globulin in large amount, had 2900 cells to the centimeter and did not reduce boiling copper solution.

March 19. Lumbar puncture was not successful in obtaining fluid. By a cistern puncture 17 cc of turbid fluid were removed under marked pressure; 5 cc of serum were introduced. A few hours after the cistern puncture the patient has convulsive twitchings of the face and extremities.

March 20. Twelve cc of cloudy fluid were obtained by a cistern puncture and 8 cc of serum were introduced.

March 21. Rigidity was still present although not as marked as on admission. The fontanelle continued to be slightly depressed. Vomiting of a projectile character occurred for the first and only time while the child was under observation. On this date also it was noticed that the sclera of the left eye was injected. Subsequently the left eye developed panophthalmitis. Permission to remove the eye was refused and the condition eventually subsided with a subsequent atrophy—the right eye fortunately remaining normal. (The eye was examined and treated by Dr. H. M. Langdon and Dr. A. R. Renniger.)

March 22. Eight cc of almost clear fluid were obtained by cistern puncture and 6 cc of serum were introduced. No meningococci were found in this fluid.

March 24. On this date it was decided to try lumbar puncture

again, with the result that 7 cc of somewhat blood-tinged fluid were obtained under slightly increased pressure. No serum was given. A cistern puncture was then done. After the removal of 2 cc of clear fluid, which did not seem to be under increased pressure, the patient suddenly became shocked—the respiration ceasing for almost fifty seconds and the pulse being practically imperceptible. The needle was immediately withdrawn and the return to a normal pulse and respiratory rate was rapid.

March 26. Six cc of clear fluid under normal pressure were obtained by lumbar puncture. No serum was given. No meningococci were found.

April 15. By this time the baby's general condition had greatly improved. There was still slight rigidity of the neck, but other signs of cerebrospinal irritation were not present. No puncture had been performed since the one in the lumbar region noted on March 26.

April 26. The patient was discharged on this date cured of meningococcus meningitis. There was atrophy of the left eye and a shrunken condition of the tissues of the orbit.

Two months after discharge from the hospital the patient was seen and examined. With the exception of the atrophy of the left eye the cure was apparently complete and no evidence of cerebrospinal irritation, optic atrophy, hydrocephalus or paralysis could be found.

We have reported this case because we wish to call attention to the applicability of cistern puncture to infants, and because, as far as we have been able to ascertain, this is the first case of subarachnoid block due to the meningococcus which has been cured by cistern puncture.

DISCUSSION

Dr. J. C. Gittings: It seems to me that it would have been more appropriate to have a neurologist open this discussion. However, I want to congratulate Dr. Mitchell upon his courage in undertaking the first cistern puncture in infants that I have heard of being done in Phila-

delphia and also upon the success of the treatment. It seems that these examples afford a perfectly obvious method for diagnosis and treatment.

We have all been thinking of the respiratory center in the medulla and failed to notice that the fontanelle is quite easily a method of entering the spinal canal. In entering the spinal cord through the subarachnoid space we attack it directly, as the most severe lesions are in the brain. Sometimes in considering a new method of this type three things should be taken into consideration: (*a*) Whether or not the patient would greatly benefit by the operation; (*b*) whether the method would increase the danger more than the normal course of the disease without such treatment; (*c*) whether the technic is practical.

We question whether lumbar puncture will not be superseded, but there is so little we can learn from rather a brief study that it is probable meningitis will be treated through the cisternæ entirely in the future.

The question of the sudden falling off in the fluid that one obtains from cisternæ puncture is obvious in connection with the necessity for getting the serum into the cisternæ itself.

In regard to the danger in puncturing the brain, I saw a remarkable specimen showing that the danger is not so great—an insane woman had passed two needles into the skull and they had become impinged into the foramen. When the autopsy was made, after the woman had died from some other cause, it was found difficult to remove the brain from the cranium, and on investigation it was found that they were being held in by these two needles through the foramen.

The line that is given to the posterior medulla seems to me possibly carried the needle a little higher than is necessary. Certainly, the higher we go the greater the danger of injury, and the lower we go the less the risk.

The most important structures that can be injured by the slightly lower route would be some of the fibers in the medulla. I can see no particular reason why a slight injury to them would have any effect unless to produce infection.

In regard to the technic, I was very much impressed with Dr. Mitchell's experience, so much so that the last time I had to treat a case of meningitis in a twenty-months-old boy I attempted to use the cistern puncture. I had no difficulty whatever so far as getting the needle through the dura was concerned, but withdrawal of the needle brought no results, as I had entered too low, the child being unusually strong and well developed. After death, which occurred about three hours later, I found that I should have entered at a point 4.1 cm. instead of 3 cm., so that, as a matter of fact, this is an additional or rather the maximum limit I should think under two years of age.

Dr. Burr: Was this the child I saw in the ward?

Dr. Mitchell: Yes, it was.

Dr. Burr: Then I want to congratulate Dr. Mitchell very much. I saw this child and I was very skeptical whether anything would do it any good. It was a desperately ill little baby, and through my mind, as I looked at this operation, the thought ran that this child might die very soon, which really seemed not so sad, as there are much worse things than death. I did not expect at all that this child would recover, but I understand that it not only survived but is in good physical condition. Whether in years to come it is going to show mental defects in consequence of the meningitis we cannot now tell, but it certainly is a remarkable thing to see that little child with all the signs and symptoms of a severe meningitis not only survive but entirely recover. The operation was certainly worth doing.

Etiology of Hemoptysis in Pulmonary Tuberculosis

By JOSEPH WALSH, M.D.

The causation of hemoptysis, which we most easily understand, and which has been described most frequently, is rupture of a bloodvessel; the work of Rokitansky,[1] Rasmussen,[2] Douglas Powell[3] and Fraentzel,[4] and the occasional findings of individual pathologists, as exemplified by the specimen of rupture of an aneurysm on a vessel in a cavity shown before the Pathological Society of Philadelphia by Drs. Ellis and Krumbhaar on October 27, have established this causation beyond the shadow of a doubt. The other causes of hemoptysis, acknowledged as possible by numerous writers, have not been so frequently demonstrated,

[1] Hand-book of Pathological Anatomy, 1852, vol. iv (Sydenham Society's translation).

[2] On Hemoptysis, Especially when Fatal, in its Anatomical and Clinical Aspects, Edinburgh Med. Jour., November, 1868.

[3] Some Cases Illustrating the Pathology of Fatal Hemoptysis in Advanced Phthisis, Tr. Pathol. Soc., London, 1871, vol. xxii.

[4] Beobachtungen über das Vorkommen grosses Lungenblutungen ihre Ursachen und ihren Verlauf, Charite-Annalen, Berlin, 1877.

and, as far as I know, no attempt has ever been made to indicate the frequency of their occurrence. This report has these objects in view and deals with 22 necropsied cases with hemoptysis preceding death, in 8 of which the possible cause was hemorrhagic infarct twice, lobar pneumonia three times, bronchopneumonia twice and congestion once. These cases follow: The first two are of hemorrhagic infarct, and it is interesting to notice that one produced sudden death and the other death only after two months of hemorrhages.

Case I.—(Private case.) Male, aged forty years. Sudden hemoptysis of sixteen ounces, with death. The patient's general condition was good; he was beginning to improve; there was no thought of death and the hemoptysis was out of a clear sky. At necropsy both lungs showed many cavities varying in size from a pea to a walnut in the midst of considerable healthy tissue and a few scattered tubercles. In addition there was a recent hemorrhagic infarct of the left lung measuring 6 x 4 cm., and not far from it a healed infarct. He had in his life four serious series of hemoptyses, one twenty years, one seven months, one three months and one immediately before death. We considered the recent infarct as the cause of the last and thought the healed infarct might account for the hemoptysis of twenty years before. In this case the lungs were cut into very small sections, and every cavity washed out in a search for a ruptured bloodvessel or aneurysm but without success. Death appeared to be due to suffocation produced by the insufflation of blood into numerous bronchial tubes. The patient had had syphilis years before, but there were neither clinical nor pathologic signs of heart disease. I mention this on account of the statement that hemorrhagic infarct is usually produced by associated heart disease.

Case II.—(White Haven Sanatorium, Case No. 5908.) Male, aged nineteen years. His first hemoptysis was of five ounces, and took place five months before death. The cause of this hemoptysis was undetermined. He steadily improved from

this time until two months before death, when he had gained twelve pounds, and his pulmonary tuberculosis symptoms had ameliorated. Then two months before death he had a sudden hemoptysis of ten ounces, following which he spit up blood almost daily, and had frequent large hemoptyses, amounting in all to 154 ounces. He had no blood-spitting for four days preceding death. The necropsy showed a hemorrhagic infarct 4 x 2 x 2 cm. about the fifth rib in the midaxillary line in the left lung. This lung, also, showed numerous scattered tubercles varying in size from a pin-head to a pea. The right lung showed a large cavity surrounded by dense fibrosis in the upper lobe and scattered tubercles throughout the rest of the lung. Death was the result of the scattering of tubercles over the last two months. There was no heart disease.

I have seen in addition two cases of hemorrhagic infarct without tuberculosis, one with large and the other with only slight hemoptysis, which I thought worth while reporting in order to show the variations in the hemoptyses:

Case I.—(Phipps Institute, Case No. 5580). Female, aged eighteeen years. Illness began with typhoid fever five months before death, and she never became entirely well. Twelve days before death she had severe hemoptysis, and for the last eight days she spit from one to five ounces of blood daily. At necropsy there was found a hemorrhagic infarct and beginning gangrene of the right lower lobe and a right hydropneumothorax. On the left there was a hypostatic pneumonia of the lower lobe. The sputum was negative for tubercle bacilli and there was no evident tuberculosis found at necropsy. On account of the pneumothorax and blood-spitting it had been diagnosticated tuberculosis.

Case II.—(Philadelphia General Hospital, Case No. B-8159.) Male, aged thirty-five years. He entered the hospital for paralysis and abscess of the kidney, of which he died. Four days before death he spit bloody sputum twice. The necropsy showed a

hemorrhagic infarct of the right lung two and one-half inches in diameter.

The following are three cases of lobar pneumonia in association with tuberculosis:

Case I.—(Phipps Institute, Case No. 7350.) Female, aged eighteen years. After only several days' illness she entered the hospital, spitting blood profusely, and died three days later. The first day after admission she had a six-ounce hemoptysis; second day, six ounces; third day, sixteen ounces, and she died three hours later. The necropsy showed acute lobar pneumonia of the right lower lobe with isolated tubercles scattered through it and a small patch of gangrene. The pneumonia was in the stage of red hepatization, and we had no reason to doubt that the hemoptysis was an oozing from this area. There were no cavities or other lesions in the lungs, except a few scattered tubercles throughout the right upper lobe. It was practically a lower-lobe condition.

Case II.—(Phipps Institute, Case No. 5268.) Male, aged twenty-four years. Four days before death he had *one* hemoptysis of eight ounces in the midst of a rising temperature, which began to rise two days previously. The necropsy showed the left lung riddled with cavities, the right lung with a cavity in the upper lobe and an acute lobar pneumonia at the base. On account of the hemoptysis occurring after the pneumonia began it was considered to be the cause of it.

Case III.—(Phipps Institute, Case No. 5327.) Male, aged twenty-seven years. Four months before death he had continuous blood-spitting for a week, apparently due to a tuberculous area breaking down, since a cavity was evident afterward which was not found before.

Six weeks before death he had a series of hemoptyses, which continued for twelve days, and varied from one to four ounces

daily, associated with a temperature of 103°. The temperature receded and the patient became better over two weeks. Two weeks before death he began to spit blood again in small quantities, with a rising temperature to 102°, where it remained until death.

The necropsy showed bilateral cavity formation and acute lobar pneumonia of the right lower lobe. It would appear that the pneumonia began about two weeks before death and lasted until the end, and this pneumonia therefore could only be responsible for the blood-streaked sputum of these two weeks, yet the fact that the previous hemoptysis lasted twelve days, a rather typical pneumonic duration, and was associated with a temperature of 103°, at least, arouses the suspicion that this, also, was due to a pneumonia of which the pneumonia before death was a relapse.

The following two are cases of bronchopneumonia:

Case I.—(Philadelphia General Hospital, Case No. C-5943.) Male, aged fifty-eight years. On the thirteenth day before death he had a one-ounce hemoptysis, on the twelfth day seven ounces and on the seventh day spit blood again. The necropsy showed a right pyopneumothorax with recent compression of the right lung. The left lung was markedly enlarged and showed two or three split-pea-sized tubercles in the upper lobe and seven or eight areas of acute bronchopneumonia about walnut-size throughout the lower lobe. Though search was made nothing else was found from which the hemoptysis was likely to have come, except this acute bronchopneumonia.

Case II.—(Phipps Institute, Case No. 5014.) Male, aged eighteen years. For twelve days before death he had a hemoptysis practically every day, the total amounting to about forty-six ounces. The necropsy showed bilateral cavity formation, and in the right middle lobe numerous areas of bronchopneumonia. Both from the clinical and necropsy findings it appeared that the bronchopneumonia began with an elevation of temperature, gradually rising to 102° twelve days before death, namely, the

time he began to spit blood. It seemed to me, therefore, at least possible that the bronchopneumonia might be the cause.

Case III.—(Philadelphia General Hospital, Case No. C-5031.) Male, aged forty years. Large hemoptysis (actual amount unknown, but evidently more than several ounces) immediately preceding death, but no hemoptysis previously. The necropsy showed the left lung with a large cavity at the apex surrounded by numerous smaller cavities, all containing blood, and the large one blood clots. The stomach also contained blood. The right lung showed numerous areas of acute caseation, but no cavities. The right lower lobe was markedly congested. Both lungs were cut into very small sections and every cavity the size of a pea examined, washed out and studied, but no ruptured bloodvessel was found. Personally I think the most likely source of the hemoptysis to be an undiscovered ruptured bloodvessel, but that the congestion must be considered as possible. If the congestion was responsible it is probable that there would be a gradual oozing with insufflation into cavities and other parts of the lung, and the eventual large hemoptysis was the result of blood pouring from these different parts.

In other words, out of 22 cases of tuberculosis with hemoptysis preceding death, in 3 there was a positive, in 2 a probable and in 3 a possible cause other than ruptured bloodvessel to account for it. Though Laennec[1] considered hemorrhagic infarct as the most common cause of large—and oozing from an inflamed bronchial mucosa the most common cause of slight or moderate—hemoptysis, and considered ruptured bloodvessel as only a rare cause, the frequency with which Rokitansky,[2] Rasmussen,[3] Powell[4] and Fraentzel[5] found ruptured bloodvessels had allowed hemorrhagic infarct to be forgotten and congestion ignored. I might add that fifteen years after Rokitansky pointed out a certain number

[1] Treatise on the Diseases of the Chest, 1838.
[2] Loc. cit.
[3] Loc. cit.
[4] Loc. cit.
[5] Loc. cit.

of ruptured bloodvessels, Herard and Cornil,[1] following a careful study, still insisted that this cause was not so common as congestion.

DISCUSSION

Dr. Landis: I have been much interested in Dr. Walsh's paper. He raises the question as to whether hemoptysis occurs from other causes than by ruptured bloodvessels.

It has seemed to me that while many of these cases of hemoptysis occur in advanced cases of the disease in which we would expect the rupture of an aneurysmal condition in a pulmonary cavity, that many of the cases seen early in the course of the disease might be due to congestion. A number of years ago a paper was published by a well-known author interested in tuberculosis in which he came to the conclusion that the majority of pulmonary hemorrhages were due to aneurysms of the pulmonary vessels.

It has been interesting to note that many of these hemorrhages occur while the patient is quiet in bed, and this would indicate that local congestion might have a part in the etiology of the hemorrhage. We all know in the acute congestion of any lobar pneumonia that blood-spitting is not uncommon, and I am inclined to believe that congestion accounts for many cases of blood-spitting and even hemorrhages in pulmonary tuberculosis cases. If the amount of blood reaches two ounces, certainly a ruptured vessel can be detected. I have not seen more than seven or eight cases of lobar pneumonia complicate tuberculosis, and look upon the combination of these two diseases as a relatively rare experience.

Dr. A. J. Cohen: I have noticed that when an acute lobar pneumonia follows a pulmonary hemorrhage that the pneumonia appeared to be the result of the hemorrhage rather than that the hemorrhage was a result of the pneumonia.

I have observed cases of pulmonary tuberculosis which were progressing very satisfactorily until they developed a pulmonary hemorrhage that was closely followed by pneumonia.

As Dr. Landis has pointed out, frequently a hemorrhage in very early cases would make one believe it is the result of a local or general congestion rather than a ruptured bloodvessel.

Dr. Flick pointed out several years ago that the pneumococcus was frequently found in the blood of patients who were suffering from pulmonary tuberculosis and who developed hemorrhages.

[1] De la phthisie pulmonaire etude anatomopathologique et clinique, Paris. 1867.

Dr. T. S. Githens: Apropos of Dr. Cohen's suggestion that the pneumonia may be caused by the hemorrhage, Dr. S. J. Meltzer, of New York, has conducted a series of experiments in an attempt to produce pneumonia in animals. He found that when he injected pure cultures of the pneumococcus intrabronchial pneumonia did not result, but that if he diluted his culture with fluids and then injected it that pneumonia resulted. This result appeared to indicate that the addition of fluid to the culture brought about the pneumonia. It is possible, therefore, that the presence of the blood in the bronchi from a hemorrhage might have the same effect in bringing about a pneumonia.

Dr. Walsh: My paper tonight is an abstract from a more comprehensive article on the pathological and clinical aspects of tuberculosis.

Laennec considered that the most common causes of large pulmonary hemorrhages were ruptured pulmonary vessels and infarcts while the smaller hemorrhages, he thought, were due to oozing from an inflamed mucosa. Rokitanski, Rasmussen, Powell and Fraentzel between the years 1870 and 1885 reported a series of autopsied hemorrhage cases in which ruptured bloodvessels were found.

I have the data concerning 500 cases, 60 per cent of which revealed hemoptysis at some time during the course of the disease.

I agree that lobar pneumonia in association with active pulmonary tuberculosis is not common.

Hemorrhages frequently seem to come in many patients at about the same time. Dr. Charles M. Montgomery reported such a series from the Chestnut Hill Sanitarium due to an infection, and I shall report a similar series from the White Haven Sanitarium.

I think that when the temperature rises before the hemorrhage occurs, as in the case described by me in this paper, that it well may be that the pneumonia causes the hemorrhage rather than that the hemorrhage causes the pneumonia.

The Clinical Importance of Infected Bronchial Lymph Nodes. (Abstract.)

BY H. A. HARE, M.D.

This paper, as its title indicates, was designed to emphasize the importance of considering the mediastinal lymph nodes as foci of infection in the course of many acute and chronic maladies

and as areas which are to be suspected when, during, or after acute infections a persistent febrile movement occurs for which there seems to be no adequate explanation. In some instances the lymph nodes undergo a certain amount of necrosis with subsequent encapsulation of the necrotic area by fibrous tissue, in other instances the suppurative process discharges through a bronchial tube, in others into the lung substance itself, inducing pulmonary abscess. Cases are recorded illustrating these various types.

DISCUSSION

Dr. Pfahler: I have been very much interested in this presentation by Dr. Hare, and I know I am only supposed to discuss this case from the standpoint of the roentgenologist.

The roentgen rays do not show normal lymph glands, and when they are demonstrated indicate past or present pathology—generally past pathology—and these glands if not of considerable size are likely not to be shown.

The lymph nodes that are shown most clearly are those that have developed some fibrous tissue or have in them some calcareous deposit, but these are so common a finding that we find practically all adults have them. I have seen them in my lungs, and I think practically every one in this room would show some calcareous or fibrous lymph nodes. Therefore, we find that we cannot attach much importance to them, but when we find very many enlarged nodes we do attach importance to them. We find, particularly in children, a great mass of lymph nodes in the upper mediastina. These are quite common in those children who complain of asthma and choking spells and are commonly diagnosticated as enlarged thymus, and, as a matter of fact, it is very difficult and perhaps impossible to make a diagnosis between enlarged thymus and enlarged nodes.

A pathologist has told me that he thinks that the enlarged nodes in the mediastina are due to enlarged lymph glands, and has found that to be the case in a number of autopsies that he has followed.

In certain cases we find a broad and more definite outline which we attribute to enlarged thymus. We might get a suggestion for therapy from the fact that these enlargements in the mediastina, which may be either enlarged thymus or enlarged lymph nodes, disappear, and sometimes rapidly, after exposure to the x-rays. Where the enlarged glands are near the surface it may be possible to treat with the x-rays, but where

they are deeply imbedded it might not be possible to reach them so the treatment would be effective. We have never tried it in adults, but in young children we have tried it in asthma and enlarged thymus and the conditions have disappeared and the patient completely recovered.

I think in most of these glandular cases we have to make a careful study both by lateral and oblique, as well as posterior view, when they can be demonstrated.

Dr. Anders: Dr. Hare's paper has interested me greatly. We see patients that illustrate his paper frequently, and quite often the possibility of pathology in the mediastinal glands is overlooked. The use of the whispered voice over the vertebræ of the chest is sometimes of real service in determining the presence or absence of pathology. One must have a definite idea of what the normal chest reveals when the whispered voice is used. I have found this physical sign useful in my work.

Dr. S. R. Miller: I have been interested in this condition a number of years. The only instance in which I personally have seen marked improvement in such a condition due to the use of a vaccine was in the case of an individual who for years had most marked asthmatic seizures. In a search for the cause my associate, Dr. Baetjer, made a number of protein tests and found a most marked reaction to Streptococcus viridans. The reaction was so violent that no one could doubt the sensitiveness of the individual to this particular germ. No other focus of infection could be found and the patient's symptoms were promptly relieved by the administration of a proper vaccine. There has been no recurrence of the condition in a number of years.

Dr. Pfahler: I should like to ask Dr. Hare whether in these cases there was a possibility of the symptoms being partly due to an enlarged thymus gland. In my work we not infrequently have difficulty in determining whether the shadow seen in the plate is due to an enlarged thymus or to masses of glands. We feel that not infrequently the therapeutic action of the rays is of marked benefit in certain cases.

Dr. Hare: I should like to ask Dr. Pfahler how he accounts for the beneficial results by *x*-ray therapy. Is the softened material absorbed or is it a matter of the formation of fibrous tissue?

My point is that these cases should be most thoroughly investigated and that we should keep in our minds the possibility of infection of these peribronchial glands. Asthma is still a protean disorder both as to etiological factors and therapy. Whenever we have a patient that has

continued fever that we cannot ascribe to common causes we should exclude, if possible, the infection of the lymph glands of the thorax.

Dr. Pfahler: In x-ray therapy we have occasion to see and treat numerous cases of cervical-gland involvement. We find that these cases are definitely improved by the rays. We find that the rays increase the fibrosis and thus aid in the treatment.

In certain inflammatory processes the lymph node is likely to break down and the rays must be used with caution. We feel that the rays reveal so many calcareous glands in the chest that the fibrotic process can be encouraged in cervical and intrathoracic glands by the use of the x-rays.

DECEMBER 19

Studies in Asthma

BY J. ALEXANDER CLARK, JR., M.D.

Asthma is now considered as a manifestation of human hypersensitiveness. Persons exhibiting this phenomenon react to substances, not in the least detrimental to the rest of the race, in a more or less distressing manner, and in the most sensitive individuals this reaction causes sudden death such as is seen after horse-serum injections. Among other manifestations are the hay fevers, urticaria and certain other skin diseases and the idiosyncrasies to food and drugs.

Briefly stated asthma is a reaction to foreign substances. The management consists in the discovering of these substances and either removing them from the sufferer's surrounding or in immunizing with small increasing doses of the offending substance itself. (Immunization in the present discussion is used to denote the attempt to raise the resistance. It is neither a total nor a permanent immunity.) The object of the present discussion is to present some of the problems and difficulties encountered in following this simple formula. Representatives of the drug houses have already explained how easy it is to get the most startling and spectacular results.

Our first difficulty is that there is no theory or even a working hypothesis on which to found the work. We are entirely at sea as to how immunization takes place. The whole treatment is founded on empiricism and our knowledge rests upon two discoveries. The first was performed as early as 1873 by Blackley and consisted in producing hay fever in himself at any season of the year by means of pollen injections. It is interesting to note that as early as 1833 Eliotson suggested that pollen was the cause of hay fever, forty years before it was proved by Blackley. The second fundamental discovery was by Noon in 1911 and by Cooke, working independently in this country, although the results were not published until later. In this work it was shown that it is possible to modify favorably the course of hay fever by the subcutaneous injection of pollen extract. This was the result of the suggestion by Wolff-Eisner in 1909 for hay fever and by Meltzer in 1910 for asthma, that both these conditions were manifestations of human anaphylaxis and that all the data gathered in guinea-pigs would prove of value in humans. It is not the purpose here to go into the reasons for disregarding the anaphylactic theory of asthma. Those interested are referred to Coca's article on hypersensitiveness in Tice's *System of Medicine* and to the recent article by Longcope in the *Journal of the American Medical Association.*

The first step in the practical handling of a case of asthma is the etiologic diagnosis, that is, determining the substance or substances which are capable of producing an attack. This is done by two agencies, the history and the special tests. Too much stress cannot be laid on the history. In order to take a good history one must always bear in mind that the relationship between the exposure to the irritant and the occurrence of the attack is rarely apparent to the sufferer. A history is rarely completed in one sitting. We must first train the patients to think in terms of asthma and to forget about climate, mental distress, prenatal impressions, etc.

In taking the history it is necessary to remember that over 70 per cent of all cases of asthma are due to the inhalation of the

irritant. Food asthmas are seen most commonly in children, but even here they are rare. When foods are the cause these have frequently been previously diagnosticated by the patient. The great problem then in the diagnosis of asthma is the determination of the origin of the dust which he breathes and the relation, if any, between the onset of the attacks and the changes in the character of the dust. Anything which occurs in a dry, powdered form must be considered. Special points which experience has shown to be of value are the time of the day and the season of the year in which the most serious trouble occurs; the effect of a change of residence on the severity of the attacks; to what animals is he exposed; the occupation not only of the sufferer but also of those with whom he is intimately associated.

The second method of arriving at a diagnosis is the special tests. These are based upon the fact that the skin and mucous membranes are sensitive to the same substances. Accordingly we prepare either in powdered form or in normal saline solution the various known or suspected irritants, and, in the case of the powders, rub them into an abrasion in the skin, or, what is more delicate, inject a small portion, 1/100 cc or less, of the extract into the skin, as in a Shick test. If the skin is sensitive an urticarial wheal will appear in from five to twenty minutes. This should be at least the diameter of a dime, and in the definite, marked reactions there are thin, narrow projections called pseudopods. If done on the forearm there is frequently injection of the lymphatics, as in cellulitis. The patient should be tested with all the substances known to produce asthma and with which he comes in contact.

The other special tests which should be employed are the ophthalmic, nasal and subcutaneous. The first two are only useful in cases in which there are eye or nose symptoms.

The greatest difficulties, problems, mistakes and disappointments in the management of asthma come through the interpretation of the skin reactions. The greatest cause of trouble arises from the two exceptions to the rule that the skin is sensitive to the same substances as the mucous membranes. The commonest exception

is that the skin is often sensitive to substances to which the mucous membrane is immune. The reverse is also true, that the skin may fail to react to substances which are responsible for the difficulty. Fortunately this exception is less common than the former. There are also cases, at present totally unexplained, in which a positive reaction may be obtained at one sitting and a negative reaction at a subsequent time. Usually such reactions may be disregarded but occasionally they are of importance. All positive reactions should be confirmed at a subsequent testing. There should be no exceptions to this rule.

After the diagnosis is completed the real study begins. At this time all patients may be divided into two groups: those which give positive reactions and those which do not. Let us consider the former group first. The problem here is to interpret the reactions in the light of the history and determine which, if any, are capable of causing the symptoms. Cooke has formulated two postulates which must be fulfilled before we may assume that any substance is of etiologic importance:

1. There must be a positive reaction, either cutaneous, ophthalmic or nasal, or we must be able to reproduce the asthma at will by contact with the substance, either by inhalation, ingestion or subcutaneous injection.

2. There must be a history of sufficient contact with the substance to produce the symptoms.

So in the interpretation of the reactions each positive is considered separately, always keeping in mind that a large proportion, about 50 per cent of asthmatics are sensitive to more than one substance and complete relief is only possible when all the offending substances have been discovered. All positive reactions may be put into the following groups:

1. Those in which the history proves that the mucous membranes are not sensitive even though the skin may be quite sensitive. Into this classification come the cases which give definite reactions to ragweed with a total absence of trouble at this season of the year.

2. Those which are positive but with which there is no history

of contact. Substances placed in this group should never be forgotten, and every effort should be made to elicit any possible contact. The sufferer is not always aware of the contact.

3. Those reactions which are confirmed by the history but which have no bearing on the present problem—the drug asthma for example.

4. The last and most important group are the positive reaction to those substances to which the patient is exposed sufficiently to produce the symptoms. It is in this group that the history is of the greatest value. A diagnosis is not justifiable if not confirmed by the history. For example, exposure at rare intervals will not account for a continuous type of asthma.

Having determined the diagnosis, that is, which positive reactions are of significance, we proceed with the treatment. The treatment of choice is the elimination of the cause. Where this is totally impossible, as in the pollen cases, horse dander, face powder, house and occupational dusts, where a change would mean undue hardship, immunization must be attempted. Even in these cases a certain degree of elimination is possible and is a great help.

Immunization, or raising a patient's resistance to a substance to which he is sensitive, is accomplished with increasing doses of the offending substance, starting with a dose which is easily tolerated and increasing at each dose 20 per cent to 100 per cent of the preceding dose according to the extent of the reaction produced. Here there are many problems and difficulties. Our greatest difficulty is that the process has no adequate theory as to what actually happens. It was originally attempted because it was thought that the process should be identical with that used in desensitizing anaphylactic guinea-pigs. It was soon found to be a much more difficult task and that none of the laws of anaphylactic desensitization were applicable. However, the procedure had already proved its worth and has been retained on purely empiric grounds.

Immunization is far from being a panacea. In certain cases only a few injections are necessary to give protection. In others

the procedure is long and tedious, accompanied by many sore arms or more or less mild constitutional reactions. There are cases in which it seems almost impossible to go beyond a certain dose, even with the most moderate increase each time, without producing constitutional reactions. A schedule of dosage, satisfactory for one person, may be totally inadequate in another, and in still another may be much too rapid an increase with a consequent overdosage. There is undoubtedly a difference in the ease with which immunization is accomplished, depending upon the substance used. For instance, grass pollen is much easier to immunize with than is ragweed. Horse dander is probably the easiest.

Another problem in immunization is overdosage. This occurs in two forms, the acute and the prolonged. The acute form is identical with the constitutional reaction. The symptoms vary from mild asthma to severe asthma, urticaria, angioneurotic edema and collapse. It occurs instantaneously, within an hour after the injection, and is rarely of long duration. The only damage is the discomfort to the patient. After an acute overdosage the subsequent injection need only be slightly less than the dose which caused the trouble.

In the prolonged form of overdosage there is no acute stage, but within a few hours a general increase in all the symptoms is noted. This increase will last for several days and improvement will be gradual, extending over a period of about ten days. During this period the patient is entirely out of control, and even a very small dose of the offending extract, much smaller than was formerly tolerated in comfort, will only exaggerate the symptoms. No dose should be given until the gradual improvement is over and the symptoms have started to increase spontaneously. The dose here should be about 25 per cent of the previous dose. This reaction is seen much more frequently with some substances than with others. It is seen most commonly in ragweed immunization and accounts for many of the failures in late hay fever.

From the above discussion it will be seen that immunization

is not always successful and is usually associated with difficulties. It should never be attempted unless it is impossible to remove the offending cause. It should never be attempted to satisfy the whim of a patient.

What is the explanation and the mode of procedure in the second group of cases—those which give no positive reactions? There are a number of possibilities:

1. They may never have been tested with the substance which is responsible for their trouble.

2. That the skin is not sensitive while the mucous membranes are. This has been definitely proved by Cooke in those cases which get asthma but no urticaria from aspirin. In these cases the skin reaction is negative to aspirin.

3. Another possibility is that the reaction may be delayed and prolonged. We know that this is possible in urticaria, and that even in well-established cases it is impossible to demonstrate any skin reaction.

4. Still another possibility is that the asthma is caused by sensitiveness to bacterial proteins. While there are many very interesting observations along this line, and while undoubtedly bronchial infection aggravates any asthma, we do not feel that the advocates of this theory as a primary cause have proved their case. Cooke has been unable to convince himself of a single bacterial case in over 3000 cases studied.

There is an interesting phenomenon which we are observing at this season of the year and which is quite unexplainable. A recent case will illustrate: A woman presented herself at the clinic with a history of hay fever and asthma for a number of years, starting in the middle of August and ending at the first of October. Last year, however, the hay fever ended at frost as usual, but the asthma continued until Christmas. This year the asthma had persisted until she came to the clinic on November 15. Skin and eye tests were strongly positive with ragweed extract. A single small dose of ragweed produced a very marked amelioration of symptoms. Here, then, we have a case of asthma originally produced by ragweed but persisting long after the re-

moval of the cause and very amenable to specific treatment. This is not an isolated example. It is quite common at this time of year. We call it a "hang-over."

As for the correction of nasal deformities and the removal of foci of infection the asthmatic is entitled to as much respect as any other individual. Nasal obstruction is more of a handicap to the asthmatic than to the normal man. There is one side of the situation which the rhinologist does not see and which we see continually, a large percentage of all asthmatics applying for treatment give a history of one or more nasal operations. Some were relieved for various periods of time, some were failures from the start and a few were made worse. In quite a few the onset came shortly after such an operation. This number is too large to be a mere coincidence.

In order to give an idea of the relative frequency of those substances producing asthma, Chart I has been prepared. 203 positive diagnoses were obtained in 143 patients in a consecutive series. A positive diagnosis means that we are reasonably sure that the patient if brought into contact with a sufficiently large dose of the substance would develop an attack of asthma. This conclusion has been arrived at after comparing the history and the skin reactions.

Chart II shows the diagnostic results on the same series of 143 consecutive cases. A complete diagnosis means that there is every reason to believe that all the causes of the asthma have been discovered. A partial diagnosis means that while some of the causes have been discovered there still remain one or more unknown factors. The doubtful cases are those in which positive reactions have been obtained but in which further study is needed to confirm the belief that these are factors in the production of trouble. These are the recent cases or those which made only a few visits. The last group are the total failures in diagnosis. Cases frequently change groups with new developments.

The prognosis depends upon the group. In the first group it is excellent if the substances can be removed from the patient's environment.; otherwise it depends upon the success of im-

munization. In the second group it depends upon the importance of the undiscovered causes plus the ease with which those known can be handled. In the third group the result depends upon the further study of the case. The last group represents the total failures as far as specific treatment is concerned. At any time further study may change the individual grouping. It is conservative to state that 75 per cent of those in the first three groups obtain some measure of relief.

It is important to remember in all questions of prognosis that no attempt is made at a "cure." The word cure presupposes a return to the normal state. We believe that this is impossible at the present time except in those cases which lose their hypersensitiveness spontaneously. For example, it is common to hear of persons who had hay fever as a child. Those who are totally relieved by the avoidance of some substance are not normal, because a normal man is not restricted in his activities. The most successful results obtained with immunization are only relative. It is always possible to bring on the symptoms by a large subcutaneous injection. And immunization is not permanent. Left to themselves these cases will all return to their old state of hypersensitiveness.

In conclusion, in spite of all our failures and mistakes, the prognosis in asthma is better today than ever before, even better than it was six months ago. New possible diagnoses are being added from time to time and research is being carried on in various parts of the country from a purely scientific standpoint.

DISCUSSION

Dr. Robert A. Cooke: It has been a great pleasure to me to come to Philadelphia to discuss Dr. Clarke's paper for two reasons: (1) It brings back to me a pleasant visit here two years ago, when I spoke on a similar subject before the College, and (2) because it has been a pleasure to hear Dr. Clarke's summation of the present status of human hypersensitiveness. In general you may say that if bronchial asthma is not a particularly serious disease, why spend so much time worrying about it ? As a matter of fact, it is an extraordinarily chronic disease, or rather

we should speak of it as a symptom. It is one of the chronic disturbances which produces a great loss of time and a tremendous waste of energy. Bronchial asthma, as I said frequently, is only a symptom of other trouble. It also opens up a wider field among similar disturbances belonging to the same group.

Human hypersensitiveness may possibly be solved by study along scientific lines.

The term "bronchial asthma" is a very vague one. All cases associated with respiratory effort are not bronchial asthma. If we exclude from the group what we consider a genuine cardiac asthma, and if we also exclude renal disease associated with dyspnea, bronchial tuberculosis and paroxysmal cases caused by the pressure of a tumor—if we reject these cases we can fairly say all cases of bronchial obstruction belong under the general classification of bronchial asthma.

The question arises, Are all these people really hypersensitive? The chances are that they are not all hypersensitive, but a tremendous group are, and it is the study of this group that led us to investigate the surroundings to give us an insight as to the cause of the irritation in order to get satisfactory results in considering the case. The respiratory tract is the method of entrance for the specific irritant, and this must be emphasized, for as Dr. Clarke has stated, and in the groups of cases which we have studied—we take the cases of asthma that occur—we find that 70 per cent of them have an asthma that is definitely caused by the irritation of something in their environment that they actually breathe in. The other cases, then, are rather limited, but a small percentage is caused by foods, particularly in children. We see asthma caused by eating eggs, meats or fish, but the percentage does not run higher than 3 or 4 per cent. Of the important group the inhalant factors are receiving the most attention in our clinic, because they have reaped the best results in the way of a diagnosis.

We devised some time ago a method in which we could determine in an individual whether or not he was getting his asthma from his environment, whether in his home or at his work; this was taking the dust which we took from the individual's environment and making an extract the same as from pollen, subjecting it to the same means of sterilization, and find that it will produce asthma. It does not tell us what it is but it tells us that there is a sensitiveness. We find that cases which Dr. Clarke has put down as "house dust" constitute a very large percentage. This study of dust has been a very interesting one from several points of view in our clinic, because of the insight it gives into the customs of domestic life. An enormous number of children, particularly among the races that come from the central European and Russian countries, who use

pillows and mattresses and do quite an extensive business in New York (as I presume is done in other cities), using rabbit hair for pillows. Among the Italians they use goat hair, all imported. We often find cases of bronchial asthma among these people; we advise them to get rid of their goat-hair pillows or their rabbit-hair pillows, and the results are entirely satisfactory.

Though we have studied these various dusts in this way, and though we are oftentimes able to determine the specific substances in the dust brought from some of the houses, there are substances present in ordinary homes which we are unable to identify. The dust causes a reaction, but we are unable to identify the particular substance from which that dust arises. In these cases it is simply a matter of keeping the house as free from dust as possible—using the vacuum, if you can, and by all means put your homes in such a condition as to absorb as little dust as possible. A study of the factors that enter into the dust of an individual's environment show approximately 75 per cent of all cases of asthma that come to the clinic arise from this cause.

Now as far as results in treatment are concerned it is not always satisfactory because of the character of the population with which one deals and their individual susceptibility to education. We have sent nurses to their homes to instruct and educate them, but they continue to go on in the same way. This method, then, of studying the dust in order to determine the nature of the irritant has yielded very satisfactory results. Now the excitant causes are not all due to this general group of cases. Dr. Clarke has called attention to the bacterial asthmas and mentioned the situation as it is today, and I may emphasize it a little when I say we are able to diagnosticate approximately 75 per cent. That means that in the undiagnosticated group of cases we had 25 per cent as undiagnosticated as bronchial asthma. The proof of a condition is difficult. How would you prove that a case was really bacterial asthma or not? If it is susceptible to proof at all, or if bacteria act as other substances act that we find among pollen and dust, then this should be proved along the same lines. In other words, extracts of bacteria should produce the same reactions as we get with the pollen extracts. So far we have never been able to produce a substantial reaction by means of a fixed bacterial protein. Of course, I do not mean to say that bacterial infection does not occur, because it does occur in all cases, but that it is a primary etiological factor has not yet been proved.

I do not think I can add anything to what Dr. Clarke has already said, but I do think that you here in Philadelphia are particularly fortunate to have a man who is ably and conscientiously studying asthma along these lines, and I know that Dr. Clarke is in a position to seriously undertake this work among you here.

Dr. A. J. Rubenstone: I have been making cutaneous tests with bacterial proteins and have met with failure so far as proving that the disturbance in the respiratory tract was caused by bacterial infection. The organisms undergo metamorphosis and sometimes a half-dozen cultures will be obtained.

Dr. H. B. Wilmer: This has been a most interesting paper. In my experience in my limited number of cases I have gotten rather excellent results with bacterial autogenous vaccines, especially among children. I cannot give the number of cases, but I have been called in consultation with several members of my profession in Germantown and have been especially impressed by the results of autogenous vaccines in children.

I should like to ask whether Dr. Clarke has noticed anything particular in blood-pressure in all asthmatics as low. My experience has been that the blood-pressure is extremely low; in practically all my cases I do not find the blood-pressure above 110 systolic with possibly a diastolic of 70.

Another question I should like to ask is, if he has noticed anything particularly in the family history in asthmatics. My experience has been in most every instance that it seemed to be inherited from the mother's side of the family.

Dr. Simon S. Leopold: I should like to say a word about the bacterial phase of the question. I have made some experiments trying to secure bacteria from the sputum, making a bacterial vaccine, hoping to get a specific organism and arrive at a conclusion, but got negative reactions.

Although I cannot explain it, I have never seen a constitutional reaction with the use of autogenous vaccines.

Dr. S. Solis-Cohen: This is a very interesting paper and has raised a large number of interesting questions. The house dust, it seems to me, is the most important thing that has been brought forward tonight. I should like to inquire whether in the cases of investigation of house dust it has been found that an individual would respond to the dust from his own house and not to the dust in his neighbor's house, or is there something in all house dust that excites the symptoms. This would be one step toward determining the particular substance. There is also dust from various insects which might be among the factors.

The question of exciting causes is only a very small part of the primary cause of asthma.

Dr. Clarke: I do not think either Dr. Cooke or myself stated that vaccines were not useful in the treatment of asthma. They are and often give a great measure of relief, but our experience with them has been rather disappointing, because we have not obtained the results which we hoped for. We do not usually start with a vaccine until we have tried everything else, and while it will help one to clear up a case to a certain point, our results have not been very encouraging. While we have had constitutional reactions, nausea and vomiting were rarely seen. We practically always get quite a considerable urticaria, and at times edema around the face and eyes accompanied by nausea, vomiting and symptoms of collapse.

Blood-pressure is low almost always, although we have seen asthma in a patient with a blood-pressure of 200.

The family history is a positive thing, although personally I never noticed any more trouble from the mother's side than from the father's side.

To Dr. Cohen's question in regard to dust, we have always seemed to get a good reaction with various forms of dust, and while one will get some sort of reaction with dust from neighboring houses, the dust from a person's bedroom will give the strongest reaction. Perhaps dust from Philadelphia taken to New York would not cause reaction on individuals there, and dust from New York would not work in Philadelphia.

In some cases the individual will have trouble while at work and other cases only have trouble when at home. In some cases caused from horse dust the case is more aggravated on a rainy day.

Remarks before the Section on General Medicine

BY RALPH PEMBERTON, M.D.

Charts were presented illustrative of the rough parallelism between a lowered sugar tolerance and the severity of arthritis. These charts also illustrated that during a lowered sugar tolerance there were changes in the blood gases in the direction of a higher percentage saturation of the venous blood with oxygen. Figures were shown indicative of higher values in the venous blood of arthritics as compared with normals, and certain possibilities as well as limitations were emphasized in interpretations based on these figures.

Differential Blood-pressure in Exophthalmic Goiter

BY JOSEPH SAILER, M.D.

In 1909 Holtzmann, at the suggestion of Leonard Hill, measured the arm- and leg-pressure of aortic regurgitation and found that the leg-pressure was higher than that of the arm. Hill confirmed this and found that the same variation was also seen after violent exercise if the hand or foot be placed in hot water and at the first reading in old people. He believes that it is due to the higher systolic wave in the arteries of the leg under abnormal conditions. Hare, in 1910, called attention to this sign and emphasized its value in the diagnosis of aortic regurgitation and its rarity in other conditions previously noted by Hill and Fleck in 1909. In 1912 he noted that the difference in aortic regurgitation was abolished by putting the foot in hot water, also noted in the previous paper. All these results were done by palpation. In 1916 Taussig noted that the pulse-pressure is usually high in exophthalmic goiter and the systolic pressure moderately high, and that in this and other respects the vascular phenomena resembled those of aortic regurgitation. He therefore tested the leg-pressure in these cases and found a constant difference, the systolic pressure being higher in the leg by 20 to 51 mm., and the average difference being 37.3 systolic and 7.6 diastolic. Trauber's sign was often present. In non-toxic goiters this difference was not present.

The only interest in these cases lies in the presence of a single common feature, the high pulse-pressure. There are various lesions in the hearts, and right preponderance is actually more frequent in this very small series. The basal metabolism in the single case in which it was tested was within the limits of normal variation.

There is no data upon Taussig's cases. In aortic regurgitation the pulse-pressure is high, but leg-pressure is almost constant,

and there may be mechanical factors that might be assured to contribute to the change. Hill believes that the tension of the arteries has an important influence, but as the change may be produced by exercise it cannot be important, for the arteries would change equally. Stengel has suggested that the velocity of the blood stream due to the high pulse-pressure may carry it past the openings of the subclavian, but there is no proof of this.

A cuff twelve inches broad was used which practically eliminated any chance of pressure which may have occurred as a result of a narrow cuff (which does not work as well around a good-sized thigh as it does around a slender one). I did not find that the cuff made such a difference as we had been led to believe. As a matter of fact we have taken the pressure with the patient lying on the face, placing the cuff around the thigh and auscultating in the popliteal space, and then we have taken the pressure with the patient lying on the back and auscultating the thigh. The 65 cases I have reported do not by any means represent the total cases.

DISCUSSION

Dr. H. C. Bazett: Dr. Sailer's paper was very interesting to me, since the results that he and others have obtained in patients with Graves's disease, as well as those which have been obtained in cases with aortic regurgitation, can be duplicated in a circulation schema with which I have been working recently. The schema consists of rubber tubing with branches and capillary resistances made in such a way as to produce a rough model of the aorta and other vessels. Into this fluid is forced intermittently and the pulse wave recorded in the artificial vessels closely resembles those seen in blood-pressure records. Under normal conditions the curves obtained from the brachial and femoral arteries in the schema are somewhat different in shape, but show practically identical systolic and diastolic pressures. But if, then, a condition of aortic regurgitation is produced the systolic pressure in the artificial femoral may be 50 mm. or more above that in the brachial and a similar amount above the systolic pressure in the artificial heart.

These differences in pressure appear to be due to the momentum of the fluid mass lying in the artificial aorta, and are more noticeable in the femoral than the brachial, owing to the difference in the volume of the

contents of the aorta and brachial artery. The mechanical factors are complex and the differences vary according to the length and diameter of the tube and to the elasticity of its wall. The biggest differences are seen when there is a large pulse-pressure with rapid variations in velocity occurring in an elastic tube. Big pulse-pressure changes in a hard wall tube do not give the result. A large pulse-pressure resulting from a large inflow and a low arteriole and capillary resistance, a condition presumably comparable to that of a hyperthyroid case, will also produce such a differential blood-pressure in the schema if the vessel wall is elastic, but it is not so effective as aortic regurgitation.

Further work is necessary to analyze the various factors concerned, but this supplies evidence that the condition in man may be due to mere mechanical factors and thus gives some support to the theories already put forward by Dr. Sailer from a consideration of fundamental principles.

Dr. S. Solis Cohen: I wish to ask Dr. Sailer if his observations in regard to the blood-pressure were made with the patient in an upright or recumbent position, and whether allowance was made for gravity or whether gravity played its part?

Dr. Stroud: I should like to suggest aortic insufficiency as an explanation of the difference in the blood-pressure in the arteries in the brachial region and the arteries in the legs.

We had two cases in the Pennsylvania Hospital. We took the pressure by placing the cuff below the knee and also taking the anterior tibial artery and auscultating in the popliteal space. Then he placed the cuff above the knee and found that he got a higher pressure in the brachial arteries. I do not say that this will be found in a large group of cases, but we have tried it in our heart clinic and find that we get a higher pressure in the brachial arteries by putting the cuff above the knee than we get by putting the cuff below the knee.

Dr. Sailer: I think my paper served a very good purpose when it brought out Dr. Bazett's illustration.

My idea was that, probably, as the volume of a vessel increased as to the cube of the diameter and the surface only as the square of the diameter, the aorta would carry a much larger resistance than occurs with rubber tubing, which varies so rapidly as to the caliber of the tube.

In regard to Dr. Cohen's question, all of these patients were examined horizontally and allowed to lie at rest a few minutes before examination was made.

A few years ago I made several examinations of aortic insufficiency at the Philadelphia Hospital. A number of controls were used.

The Significance of the Chvostek Phenomena in Internal Medicine. (Abstract.)

BY D. J. MCCARTHY, M.D.

The phenomenon (hyperirritability to mechanical percussion of the facial nerve), originally described as a symptom of tetany and later as a manifestation of spasmophilia, is found on routine examinations of patients in a variety of internal medical and neurologic conditions quite independent of any relation to tetany, spasmophilia or parathyroid disease. This symptom was found in 43 out of 150 patients examined. Of these patients 10 were mental cases, 4 organic nervous and 27 fractional nervous cases. The phenomenon was very marked in 3 cases, moderately so in 5 and slight in 35.

DISCUSSION

Dr. H. K. Meyers: Recent investigations show that tetany and exaggerated irritability of the nerve might be explained by attachment of calcium to the tissues, or, in other words, that rachitis, epilepsy and kindred disorders are associated with metabolic disturbances in a high degree: hence we can understand that toxins circulating in the blood and the various monoproteids produce symptoms or act as a tetany. Disturbances of the blood may also cause hyperirritability to the peripheral nerves or a condition of the central nervous system which is expressed by spasms of tetany.

Dr. O. H. P. Pepper: Alkalosis may be responsible for tetany by reducing the acid content of the blood and present a potential shift toward the alkaline side. This must not be overlooked, although it is not clear yet that it does carry conviction in the many factors that fit into the picture. Two other conditions which should be considered are overventilation of the lungs and loss of acid from the stomach. This is the line along which investigation is being carried out and the line along which more information I think will be forthcoming.

PROCEEDINGS

OF THE

SECTION ON INDUSTRIAL MEDICINE AND PUBLIC HEALTH

FEBRUARY 11, 1921, TO DECEMBER 16, 1921

FEBRUARY 11, 1921

Methods of Surgical Prevention of Infection and Complications in the Injured

BY GEORGE M. DORRANCE, M.D.

As the result of my experience as an organizer and director of a health department and as a chief of an active surgical service where we receive cases from different industries, I have some very definite ideas on the subject of industrial surgery.

In order to know exactly how a system is working out, it is essential to tabulate the results and compare them with results obtained under ideal conditions. Note the time lost, the disability incurred and the compensation paid. In the business world one will be judged by these factors alone. It will surprise those connected with a health department, who think they are doing good work, to note the actual time and disability incurred by the various accidents, and it will lead to many radical changes in their mode of handling such class of cases.

Consider the personnel of the average health department. Is the doctor trained for this specific work? Unfortunately, no. Because of the low compensation of the average health depart-

ment it is often not possible to retain a well-trained man. This is a grievous error, for the director of a health department should be a man well trained in his own special line and one capable of being vested with authority. The first thing to be decided in each industry is the amount of actual surgical work required. If there is but little surgical work he should make some arrangements wherein he will be able to call upon a trained man to handle these cases. It must be definitely stated how much power his department has and whether or not he is going to be subsidiary to a superintendent, who usually does not have any idea what an infected wound or a poorly set fracture costs the firm. It is necessary to educate the superintendent.

Few plants find it economical or efficient to treat patients in their own hospitals, preferring to send them to a nearby institution, where they are treated as ordinary hospital cases. I have found this to be the source of greatest expense. In most states we have compensation where they pay the per diem rate to the hospital for the treatment of these patients, but they do not pay the surgeon for his services. What usually happens to an injured man? He is given first-aid attention at the plant and sent to the hospital receiving ward, where he is treated by an intern who may or may not have had experience, who may or may not be particularly interested in his work, and who may not know anything about the condition he is attempting to treat—rather a haphazard method, and one which would not occur in any other department of a well-run business. I am not saying this with any reflection upon the hospital, but simply stating a fact.

Let us assume we have a wound which requires suturing. This is, as a rule, done in the dispensary, where the technic is not perfect and a certain percentage of them develop infections. Those of us who have looked into this problem realize that if these cases are handled by trained surgeons the patient would have been given perhaps first-stage anesthesia, the wound and surrounding area properly cleansed and the wound sutured with or without drainage under careful techic. You would usually have primary union, and the patient would be well within ten days.

Now let us look into the reverse of the picture. If the patient becomes infected the sutures are removed, the pus evacuated and dressings applied until it heals by granulation, which, depending upon the case, may take approximately three weeks and frequently a much longer time. The injured employee has suffered a great deal of pain and now has a granulating wound with possibly a certain amount of contracture or deformity.

This is a pure case in which the industrial concerns and insurance corporations think they are getting something for nothing, whereas they are mistaken, and instead are getting a very expensive method of treatment, for infections are expensive.

You all realize the vast amount of infection which is prevented by the first-aid treatment of all small wounds and how you would not care to go back to the former method of having a fellow-employee taking care of these cases. My idea is only a continuation—an outgrowth of the first aid. Industrial surgery resembles war surgery more closely than any other branch of medicine, and even more extensive wounds, if carefully cleansed and the débridement treatment applied—*i.e.*, surgical removal of all dead tissue—will heal by primary union. Let us go a step further and consider a wound in which a tendon has been divided. The usual thing in the out-patient department is to suture that tendon under imperfect asepsis, and the usual result is infection with loss not only of that tendon but extension of the infection up the arm, necessitating subsequent incisions. In clinics in which a careful record has been kept the history is as stated above. If the cases have immediate operating-room treatment and the wound cleansed and the tendon sutured, primary union without infection will be the rule. If it seems best not to suture but to wait, fearing infection, and later none occurs or occurring is combated, the wound may be reopened and the tendon sutured.

Here also comes the question of splinting. In practically all wounds of the arm and forearm a splint is advisable because it is a well-known rule that rest is the primary requirement for healing.

As we all know, there is no more difficult branch of surgery

than an injury to the joint, and the treatment of injuries to the joints has been brought out lately by Wilhelm. He teaches that even the simplest compound wound of the joint should be a hospital case, taken to the operating room and all diseased and injured tissue removed and the tissues below the skin sutured, skin sutures introduced but not tied, and a few hours afterward—some time under six—passive motion of the joint started and continued at least four times a day. In this way by prompt surgical cleanliness and avoidance of infection the joint is saved. Later the joint irrigates itself by pressing the fluid out during the manipulations. Subsequently the skin sutures are tied. There is no discussing this point, as it has been well proved in war surgery, and those of us who have had experience in this branch of surgery find the final result is usually a freely movable joint, practically normal.

We all know what happens to the joints under the older method of treatment. The usual story is this: In the receiving ward they are cleansed with soap and water, sutures put in and a splint applied. If infection has already entered the joint it becomes infected, and if it does not become infected it at least becomes moderately stiff, and after passive motion is started it usually required weeks or months to recover the function. Added to this there is increased pain, prolonged compensation and disability. In the larger joints, *e.g.*, knee-joint, you may be forced to do an amputation; even then, death may result from sepsis.

If these joints are operated within six hours infection usually does not occur. However if there is marked laceration, and possibly complicated by a fracture, it required the proper decision as to whether to amputate or do an immediate excision. Here is where experience and competency are absolutely essential. My experience has been that in a large series of cases your mistakes will most often be in trying to save too much, and by trying to save them you lose possibly a large portion of the hand, foot or leg. In all events these cases should have the immediate attention

of a surgeon. If fractures are compound there is no question that they should be carefully operated on within six hours, in the operating room, cleansed and débrided and closed tight, thereby becoming a simple fracture; or if this is not possible, apply the Dakin-Carrel treatment with secondary suture. If they are not débrided, and the old method of reduction is employed, a large percentage of them become infected, with subsequent osteomyelitis, with its ensuing multiple operations and deformity. War surgery has taught us much about the treatment of this type of injury, and the surgeon who was not fortunate enough to be at the front must learn from those who were there, because the results were such that it revolutionized our treatment of these wounds. I have followed out this method in civil practice and have found this treatment particularly applicable in industrial surgery.

Let us consider the question of treating ordinary fractures: What industrial surgeon has not had cases returned to him with marked deformity? You know some surgeons take exceptional care of their fractures, while others leave them to their assistants. The point I am bringing up is that these industrial concerns leave it to the director of the health department to handle the problem, and as far as I can find they are dependent upon you to see that they are handled properly. Are you making the hospital a dumping-ground, letting them handle your patients anyway they see fit and not checking up the results, or are you selecting the surgeon and checking up his results? If you will check up you will find you are having too many infections by sending the patients to the out-patient department, and—as I have said before—to an inexperienced house doctor who, however desirous he may be of performing his duty, has not had the experience he should have in order to treat these cases properly.

I appreciate your answer is that we should correct our hospitals. They could and would be corrected were it not for the fact that the health departments, the manufacturing concerns, the insurance companies, etc., are attempting to get something for nothing,

and in these days of running hospitals that cannot be done. You have all had the lesson of what first aid has done for you in your own factory. If you will enlarge upon this, carry it further, and use a check-up system you will find that it will pay your firm in cold dollars and cents, and that, apparently, is the only way you can reach an insurance company. Have these cases treated early by an expert rather than wait until you have complications.

Now let us go further into fractures. It is admitted, of course, that an x-ray will be taken in all cases. These cases should be x-rayed shortly after their admission and the fracture carefully reduced under an enesthetic and a second x-ray taken to check up the reduction. If the result is not perfect the patient should be etherized again and the bone reset, for if the bone is not correctly set primarily it will be impossible to get a perfect result. If you cannot retain your reduced fracture in correct position it will be necessary to apply traction to obtain this perfect apposition, because, after all, if it is not cared for correctly primarily no subsequent treatment is going to reduce that marked deformity. If the reduction is correct the extremity should be placed in a splint and massage started early. In reviewing your past cases, how many times have you found the bones perfectly set, the arm kept on a splint, dressing inspected every day or two, and when sent back to you, with the statement that the fracture had united, you found atrophy of the muscles and stiffness of the joint or joints with marked limitation of motion? Compare this with a case that was well set, had early massage, keeping the joints limber, the muscle tone good and the vascular supply stimulated. At the end of the treatment of the fracture your patient is returned to you with normal motion, joint almost normal, very slight atrophy of his muscles, and in a few days is able to go to work. View these results from an industrial standpoint. The latter will be able to do normal work in ten to twelve weeks, the former one depending upon the location of the fracture and the amount of joint involvement will return in from three to nine months, and possibly not then. As you well know, those people with stiff

joints and limitation of motion are afraid to go to work because the minute they sign off with the insurance company their compensation ceases. You all know of such cases. How much better it would have been to have spent the money on careful early surgical treatment and massage than to have paid in compensation and loss of time, and not only the loss of time, but the expense incurred in the factory by that particular man being out. This must always be calculated. The same holds good in the lower extremity. If you have a fracture it must be set correctly and the bones must be held in apposition. If these can be set, placed in plaster, and held in apposition so much the better. It is well to know that the *x*-ray should always be taken after the patient has been put in plaster, otherwise weeks afterward deformity may be found to be present. After a length of time varying from ten days to two weeks the cast is cut, spread and very light massage given, and thus the tone of the muscles and circulation is kept up. I assure you this will always decrease the amount of time required for the fracture to unite, for stagnant blood supply does not stimulate bone-growth. If this is done he will be out of the cast in less than eight weeks. Now if at the end of the same time an extremity that had been in a plaster cast is taken out you will find his muscles have atrophied and his joints are stiff, and when he is told to walk on his crutches, too frequently, on account of this atrophy and the relaxed condition of his muscles, he develops flat-feet, unfortunately a very common complication after a fracture. Compare this with the man who has had his massage. He has very little atrophy of the muscles and no stiffness of the joints. They are of very much better tone and prevent the development of flat-feet.

Under the present system you have no way of checking-up the doctor at the hospital nor can you require him to obtain perfect results. In order to stimulate him to save money for your firm you must recompense him in some way. As far as I can see, in a fairly large surgical experience, I have never heard from an insurance company of the satisfactory results obtained. On the

other hand, they are ever ready to criticize the hospital surgeon for any except proper results. As I stated in the early part of this paper I am on both sides and therefore I am in a position to know. Who of you have not had fractures come back to you in malposition and have had to refracture them? Before I checked-up and convinced the insurance company that it was cheaper to pay the surgeon than to take chances on deformities we had had several. Now it is a rare occurrence and the insurance companies are satisfied that they have saved a considerable sum of money by having these cases looked after by someone who is interested in their side and who knows that his results are going to be checked-up not only by the surgeons of the company but by x-ray, and if they are not found to be satisfactory he will be called to account. I assure you you will receive a different type of work. You cannot control the appointments to the different hospitals because they are made for various reasons, but you can control the surgeon doing your work or you can have the patient sent to another hospital where you can have a particular surgeon on the staff take care of your cases.

As to fractures of the lower extremity, all the surgical experience has been that in a certain large percentage of the cases it is impossible to hold these bones in perfect apposition by the fracture box, by the cast, by a Thomas splint, etc., with extension applied to the skin. Those of you who will take interest enough to try it on such cases will find that traction applied to the bones directly by means of so-called ice-tongs or pins that these fragments can be pulled in perfect apposition by gradual traction overcoming the muscular pull, and it is the muscular pull that causes the deformity and usually not the primary injury. It has been stated that a man is practically never able to go to laboring work after a fractured femur. In young men below the upper third of the femur it is not true, providing the bones are set correctly. As far as my present experience is concerned this can usually best be obtained by actual bone traction and the Thomas splint with the Balkan frame. These cases must be massaged daily after

the first few days to prevent atrophy of the muscles with its subsequent disability.

The injured employees appreciate having a careful person treat them who is interested in them and their welfare rather than to feel they have been shoved into a public ward with its rotating services. It is an interesting psychologic point that corporations and firms who give large sums of money to various charitable institutions expect their employees will be carefully treated there, fail to realize how much better it would be if a similar sum were given to a surgeon to look after their cases. It cannot be expected that the health doctor can have all this experience, but he can have the experience of checking the results up, and after a year I feel sure he will have similar views to mine. All the big steel mills have already noted the value of this method. It may be that because of their position they have been in isolated spots, where the surgeons have not been as skilful as in this area. You cannot expect detailed treatment for nothing. I can assure you that the surgeons are reasonable, but many of them hold that they have been unjustly dealt with by corporations and firms expecting them to give services for nothing, which they would not expect from any other class of men. The industries assuredly do not employ their legal talent in a similar manner or even their veterinary surgeons.

My opinion is that it pays the firm to have these patients treated by an expert who is not only interested in the patient but who is interested in the firm, and that he in turn shall receive a just recompense for his services. I have been able to prove this to insurance companies and they have allowed me to select the surgeons, and as I was not in a position to handle their cases, after careful consideration I selected surgeons who were available and arranged a scale of fees. Since then the coöperation of the surgeon has been apparent to all. He is part of the organization, so, of course, is interested in our problems. This is the way it should be.

FEBRUARY 11

Defects in 1500 Employees and How the Defects were Handled

BY B. FRANKLIN BUZBY, M.D.

The question of what to do with physical defectives in industry is an unsettled one as far as I can learn, and while the number of examinations reported in this paper is comparatively small, still the disposition of the partially unfit is perhaps the same in all plants, large or small.

My work has been done at the plants of the Keystone Leather Company and the Joseph Campbell Company, both in Camden, N. J., so that the labor supply is the same in both cases. All the subjects examined were males, and all had the same examination, with the exception that one-third (500) only had urananalysis; but since the type of men was about the same at both places I feel that the small number will, in part at least, give us an index as to possible kidney disease in workmen.

A word about the completeness of the examination might be in place in the beginning: All clothing, including shoes and stockings, was removed and the men were examined alone in the examining room. Each examination consumed about twelve minutes, and included a short history concerning previous and present occupation, age, marital condition, past illnesses, accidents or operations, venereal infections, and specifically concerning convulsions or frequent fainting spells. Then a general inspection of the eyes, ears, nose, throat, teeth, body, extremities and arms was made. This was followed by measuring of height and weight and a testing of joint and muscle mobility and examination for hernia. Then there was made an examination of heart and lungs and the determination of blood-pressure by auscultation. Then followed abdominal examination by palpation and the testing of vision at ten feet. Then, following the passage of urine in the presence of the examiner, the employee was dismissed.

Women were examined also, but as the examination was necessarily less complete their records are not included in this report.

The age of the employees varied, as is true in all factories, and all nationalities are represented such as apply for and receive work at all industrial establishments in a city. No reëxaminations are included in this list, although many were made. Instead, these were in the nature of a check-up of the condition of the defects and as to how the work was affecting those especially placed.

Many, as is well known to all industrial examiners, have comparatively easily remedial defects. The question comes up always, however—What shall be done with these employees? A year ago the spirit of coöperation in the rank and file of employees I considered to be lacking, either because of the independence of labor as a whole, or of the usual "don't care" spirit of all humans when things are going well. More recently it seems that the more intelligent at least are willing to take suggestions as to the means of attaining better health, and thus be better able to withstand the competition for employment which apparently is becoming widespread.

But in general what means shall we employ to improve the health of the worker? Shall it be force, persuasion or suggestion? With regard to force, I can say that I am absolutely opposed to saying to any man, "You must do this and so to remain at work or to get a certain position," unless it is definitely a case of protection, as will be seen later under discussion of hernia. At once his enmity is aroused, and although he may do what he is forced to do, still should any other condition arise would he consult the physician at the plant? I feel that he would not. And that is where I consider the industrial physician is either good or bad, for once the doctor has gotten the confidence of the worker at the plant, he is his friend, thus being the same as in private practice. I feel that the tendency of most of us in industrial work is to entirely overlook the side of the employee, and I might add he most assuredly has a side.

Persuasion I have found, too, to be wrong; or when a doctor has used up a half-hour or so in convincing a man with enlarged diseased tonsils or with a hernia or any other like condition to be operated upon, then should anything go wrong, either during or after operation, such as hemorrhage in the former or recurrence in the latter, the whole story goes through a plant and the physician loses friends that he has made by hard, conscientious work.

Would it not be far better, as is my practice now, to spend the same time, if necessary, in telling the man the conditions found and the procedures that could be undertaken for relief, and then, in the light of how much he values his health and ability to work, let him select his own method of treatment, and should he decide to have operative correction, or whatever down in the doctor's heart he knows is the proper treatment, then help the man in his selection of a doctor or hospital or appliance. Perhaps some will say this is passing up responsibility; but the element of force, I feel, enters into the man's mind when the physician paid by his employer says, "You should have this done."

There is surely a difference in these methods of procedure, and if the employee voluntarily chooses his own course when the various roads are pointed out to him, I am sure he has more respect for his employer than if he were told to take the road to the right. Frequently when such things are explained to the workers I have found that they consult their family physician, which incidentally I advise all to do, and he, of course, agrees with the doctor in the plant as to possibilities, and he does the advising as to what should be done, and thus since the employee is paying for this advice, he does not resent it.

To be sure, force plays some part in an ultimatum such as this: "If you can see no better than that without glasses your work will have to be changed," which in a skilled or semi-skilled worker means a demotion to the plane of a common laborer and accompanying decrease in income. Still, the man feels that he himself is deciding to have his eyes properly refracted, and he will shortly ask where to have the work done, and will not, I find, object to such remarks, for he makes his own choice.

Another question is: Should we tell each employee of any irremedial defect found and of which he does not know, such as a heart lesion or high blood-pressure or tuberculosis? I make a practice of telling every man his exact physical condition in addition to making accurate notes on it. How else is the man to be made happy in a change of work unless he knows it is for his own benefit and is willing to coöperate?

Again, in a general way: How shall we treat applicants for work as compared to the employees already at work when found to be defective? In case of the former I tell every man why he was rejected in case of rejection, and in case a remedial defect was the causal condition I would tell him the same thing as I would a man already at work, namely, how this defect could be corrected, and if corrected, I always like to be able to assure a man that he would then be able to secure employment, if any were to be had, thus again letting him choose his own procedure. If the defect is irremedial I tell the man just why he is a menace.

On the other hand, in the case of the older employees with irremedial defects, one is able to do a world of good by transfer to suitable work and by giving advice as to what to do to keep the condition from progressively getting worse. Some men naturally are too ill to work, as in the case of decompensated heart cases and tuberculosis. These should be told of the danger to themselves and to those with whom they work, and should be put into competent hands for help. In case of some employees whose length of service, loyalty and position in life have been considered, they should be taken care of in some way, such as a pension, by the company. In fact, such action is fast becoming a general practice even though the fact is not widely advertised. At any rate no employer should throw out an old employee without some sort of physical or financial benefit. Even though this may sound perhaps as the—"I am an advocate of compulsory health insurance as agitated by various labor unions," let me say here that I am absolutely opposed to it.

The idea in physical examinations in new employees, however else it may be stated, is that the employer can keep the

unfit out of his plant, but at the same time by holding up or postponing employment of those with badly decayed teeth, markedly defective vision, bronchitis, contagious diseases of all kinds, including skin and venereal diseases, hernia, severe varices without support, pleurisy, etc., until these conditions are corrected, he also actually forces health on applicants for work, and thus by having only physically fit men and women in a plant he greatly increases the productivity of the employees, thus increasing the income of himself and workers as well, and so all are benefited.

I can see no harm done provided the labor market is sufficient, as it is at present, by the employer in trying in this legitimate way to get better workmen and thus more work done. To be sure the applicants are compelled to better themselves physically should they wish to work in a particular plant; still, if it is clearly stated at the time of physical examination that such conditions exist, and until such time as they are corrected the applicant cannot go to work, certainly he will do what he can without feeling any animosity toward the firm rejecting him, especially if he gets the same answer at several plant employment offices.

To take up the various major defects individually for a brief discussion:

Defective Vision. 21.4 per cent showed vision of 10/20 or less in one or both eyes. I have made an arbitrary ruling that no man with an uncorrected vision of less than 10/30 in a skilled worker and 10/40 in an unskilled worker should be given employment. In case of those already working in the plant the same rule applied, but in this case the man was told of his defect, and that if he wanted to be able to compete with men able to see well in the same job he would have to have something done or else be transferred to some unskilled position paying less wages and to which there was no danger connected. Again, even though his vision were 10/15, if the man had symptoms of eye-strain or was making errors in his work attributable to defective vision he was told of his needs and transferred to other work until such corrective measures were taken and then given his old job. If any of these defectives were discovered to be

unable to pay an oculist's fee they were told of hospital clinics where such help could be had gratis, and all were warned against the optometrist.

Those blind in one eye or with one eye missing, making up 1 per cent of the total, were all rejected or gotten rid of because of the possibility of the loss of sight in the remaining eye and subsequent total blindness.

Diseased Teeth and Gums. 31.3 per cent showed at least two badly decayed teeth, with or without pyorrhea alveolaris. In case of applicants I postponed the employment of those with six to eight or more black snags of roots with pus exuding from the sockets of the same until the offending members were removed. I felt that in the average case far more than half the battle was won if the teeth were removed, for the man would get false teeth very quickly when he found he was unable to chew his food. With those in the plant it was very difficult to convince the average man that a tooth which was not aching could possibly be a source of trouble, but once the word had gone around that I was insistent upon clean mouths the number appearing for examination with raw, sore gums from recently extracted black roots grew rapidly. With the others I used suggestion as to the foulness of their mouths by making various revolting comparisons, and I got results, as seen by subsequent check-up examinations, at which time I found the mouths clean and the men grateful.

Enlarged and Diseased Tonsils. This condition was found in 8 per cent of those examined, and only in those with a history of repeated attacks of tonsillitis and quinsy or of some of the cardiac and arthritic complications did I suggest removal. None were rejected for this condition alone, and only in case of an acute attack at the time of examination did I postpone the employment of any of the sufferers from this.

Deviated Nasal Septum. This was present to some extent in 16.3 per cent of the men. All were informed of the condition and possible correction if repeated attacks of rhinitis occurred. It had no bearing whatever on employment.

Deafness. Present in 0.7 per cent of cases. All were rejected in case of applicants who could not, except with difficulty, hear the spoken voice. Those already in the plant were placed in safe positions, if not already there, so as to preclude the possibility of not being able to hear danger signals.

Flat and Phthisical Chest, with abdominal breathing, occurred in 3 per cent of cases. If this existed without any other active disease in the chest I advised both new and old employees as to how it might be in part overcome by exercise, especially in the young. This particular type of man, however, I kept under observation and checked-up his weight and general condition from time to time.

Myocarditis. This was found in 0.8 per cent. In this number I include arrhythmias without any dilatation of the heart, but not those usually spoken of as juvenile or respiratory types. Unless the worker already in the plant had a rather easy position, I tried to have him transferred to such in case he was symptomless, especially if the condition were accompanied by high blood-pressure, as it usually was. Those with symptoms were usually referred to their family doctor or some suitable man for treatment, and were usually laid off until all symptoms disappeared and were taken back only if their records were worthy. All applicants with this condition were rejected.

Endocarditis, by which I mean valvular disease, as shown by murmurs and enlargement of the heart. These represented 2.3 per cent of those examined. Those already at work if compensated and without any history of decompensation were let alone unless the work was particularly laborious, in which case lighter work of some type was furnished. If decompensated they were laid off until such time as they were again fit, following treatment, and when ready to return to work were given an appropriate position should their previous services warrant it; if not they were let go entirely. Applicants with aortic or pulmonary valve disease or mitral stenosis were all rejected. In case of mitral regurgitation the work to be done, as well as the general condition of the patient, was considered, and usually

such were put to work in a suitable position. In the case of skilled workers already in the plant it was a difficult matter to transfer these men because of the lessened income which must necessarily ensue. The men and foreman were both told of the conditions, and things were left as they were.

Tuberculosis. Unquestioned tuberculosis represented 0.8 per cent of the series. These were all laid off, if at work, with advice as to where to go for help, either a tuberculosis dispensary and eventually a sanitarium, or to the family doctor, if one existed. All applicants with this condition, even if only suspected, were rejected. In case of suspects already in the plant these were all given light outdoor work with hygienic and dietary advice and frequently checked-up as to weight and the physical findings in the chest, and if the disease progressed they also were laid off.

Hernia. Unilateral represented 5.1 per cent and bilateral 1.8 per cent of the total examined. There was only one case of femoral hernia, the rest representing the inguinal type. These figures bear no relation as to whether the protrusion was complete or incomplete. The New Jersey law absolves the employer from responsibility in case of the indirect type of hernia, but does not, of course, relieve him in case of an injury to the contents of an already existing sac. Therefore, it was deemed advisable to give the sufferer the choice of the radical cure or a properly fitted truss in case of the old employees. All applicants with hernia were rejected unless the man was especially skilled and his work not particularly arduous, in which case he was permitted to go to work provided he had a satisfactory truss.

Hydrocele. 0.6 per cent were suffering from this condition. If large I advised the proper treatment; if small and symptomless I advised letting it alone in case of those already in the plant. In applicants I rejected those that were larger than a goose egg, unless the man was especially fitted for some important duty and the men possible for this position were few. When larger than a man's fist all were rejected.

Varicocele. 5.3 per cent showed this, but none were rejected because of it, and all were advised to wear a suspensory for comfort. All were advised of the operative procedure possible if they were not relieved by a suspensory.

Gonorrhea and Syphilis in the infectious stage were found in 0.7 per cent in case of the former and 0.4 per cent in the latter disease. In case of men already working these were laid off with the promise of their jobs again when they were cured or non-infectious, and were also advised, if not already under treatment, where to receive proper care, and were warned specifically against quacks. This course I feel is justifiable because otherwise employees will not consult the doctor in the plant concerning venereal diseases for fear of permanently losing their positions.

Naturally in an effort to keep venereal disease out of a plant all applicants suffering from any of these diseases were rejected, but at the same time were told where proper treatment might be obtained.

Hemorrhoids were present in 8.5 per cent. All cases showing this condition were examined by rectum as well for possible carcinoma, but none were rejected for this condition alone. All were warned against constipation, and were informed of the relief given by operation.

Flat-feet were present in 3.6 per cent, and none are here included unless moderately severe or painful. These were advised to wear supports, and, if not relieved, to take exercises aimed at the strengthening of the foot and calf muscles. Only those with difficulty in getting around and pain on standing were rejected.

Stiff Joints. Stiff joints were present in 0.6 per cent. The men already working were usually in positions that they could take care of, but in case this were not true a transfer to such was effected. In the new worker unless the job fitted the individual's ability to care for it he was rejected. Here let me say a word of the need for the industrial physician to make a job analysis of his own, so as to be better able to help the employment manager to fit the round peg in the round hole. I have found that an

occasional trip through the factory is of great help in learning the name and nature of each job. Otherwise, unless this is always considered, one is working in the dark as to the needs of the job and the man.

High Blood-pressure. By this I mean more than 150 systolic. 7.8 per cent of the series showed this condition. This figure is an arbitrary one taken for classification. The sufferer already working, if symptomless and uncomplicated by some cardiac or renal disease, I let alone in his position. If, however, there was danger of attacks of vertigo or greatly increased pressure due to severe exertion I tried to have the man transferred to a safe place of labor even though the work might be the same.

If complicated by albuminuria, as some were, or with improper cardiac action, I always had them see their family doctor for observation and treatment. I rejected all above 170 if uncomplicated and those above 150 if complicated, as this appeared the only safe way.

Chronic Suppuration, be it from bone or soft parts, such as an ischiorectal abscess or suppurating adenitis, I rejected, and, if already at work, I saw to it that proper treatment was given. This type of case was not frequent, but even so such conditions occurred often enough to demand a set policy.

Skin Diseases. 3.3 per cent showed some form of skin lesion, not including eczema rubrum. Various types were met with, of course, but only those contagious ones, such as scabies and impetigo, were laid off until cured if at work, and instructions were given as to proper treatment and the precautionary measures to be taken. The others were just advised as to the proper treatment, if they were not already receiving it. In applicants eczema, if bothersome, and the work to be done were wet, and the easily transmissible types were rejected, but acne and psoriasis were passed unless they were so severe that the fellow-workmen might object to the appearance of the patient. In the Campbell plant especially one had to be careful of the appearance of skin diseases in workers handling food, for inspecting parties of civilians were frequently taken through the factory. All permitted to

go to work were advised to get treatment, and were told of the usual long duration of persistent effort necessary to effect a cure.

VARICOSE VEINS. Varicose veins were present in 4.7 per cent in moderately severe form or worse. Eczema rubrum was present in 8 per cent of the cases showing varices, and three severe varicose ulcers were encountered. Those of the men already at work were strongly advised to get elastic support, either a stocking or a bandage, and in case of men in particularly hazardous work, where the shin was liable to be struck and thus an ulcer develop, these were told of the dangers of ulcers developing under the existing conditions. In such locations some men wore shin guards. Operation was discussed but not strongly urged. Applicants with proper support were permitted to go to work, but those severe cases with ulcers or eczema rubrum were all rejected.

ALBUMINURIA. 2.6 per cent of 500 showed albumin in the urine. No microscopic examination was made, but the urine of all those noted was clear. This condition was noted in two types of employees—the undernourished and semi-sickly youth and the adult with some cardiac or arteriosclerotic changes. The cases were about equally divided. The work of each case was investigated, and if not too heavy was not changed; but all were urged to see their family physician for treatment of the condition. The applicants showing albuminuria, no matter what the cause, were rejected and advised to get in touch with a doctor for treatment.

Numerous other conditions were noted in occasional cases, and each was taken care of as it arose, but all in the same manner as herein indicated, differently in the case of men already at work and in those about to be put to work, but the conditions herein stated represented the bulk of all the defects.

A few specific instances of the transfers effected I feel would not be amiss here. A weigher with less than 10/200 vision in one eye and 10/70 in the other was put to pushing trucks until he got glasses. A laborer on a wringing machine with a blood-pressure of 205, who got giddy attacks, was put to cutting tanned skins in half. A boy on a buffing machine who developed a dry cough was transferred to a machine stretching wet hides. A deaf

man working near machinery was changed to unloading freight cars. A man working in an overheated atmosphere was losing weight and grew tired easily. He was transferred to a warehouse handling empty boxes. A man with painful flat-feet was given a high stool and was able to continue with the same work he had done before while standing all day long. A man, rather intelligent for a laborer and with a long record of loyal service, was given a job as night watchman when, due to cardiorenal disease, he was no longer able to continue in previous work. A man with eczema was transferred from wet to dry work, etc.

Conclusion. In conclusion, in summing up the work done, several points should be of prime importance to the examiner:

1. The necessity of the doctor knowing his plant so that he can fit the man to the job and the job to the man.

2. The necessity of a stripped subject so that all defects can be noted.

3. The necessity of allowing sufficient time for each examination, so that the proper advice can be given the men, for thus they realize that the doctor is telling them things for their own benefit as well as to increase production by getting them physically fit.

4. Fearlessness on the part of the examiner in checking-up the treatment being given by other doctors for various defects.

5. Finally, the industrial physician ceases to be a doctor when he becomes absolutely subservient to his employers and forgets his humane side, which he should show the employees in treating them as individuals.

APRIL 29

The Protection and Promotion of the Health of Women in Industry

BY FLORENCE L. MEREDITH, M.D.

The health of women in industry has always been considered a special problem, largely because of the necessity of protecting

the health of the future mothers of the race. That work has some effect for good or for ill cannot be denied. Even if the health of women were conceded to be as good as that of men this extra care would still be necessary. But when, as is usually the case, it is supposed to be not the equal of men, then we have a second great reason for their particular care in industry, one which would operate whether or not any of them were ever to be mothers.

Industrial life has been considered unsuited to women. It has been thought remarkable when they have done well at it and not at all remarkable when they have failed at it. Special legislation has been enacted, therefore, for their protection, and in individual factories special care has been given them. In our factory we instituted physical examinations for the women employees first.

Statistics are exhibited to show that a larger proportion of women than of men do not do well in industrial life. The most recent important statistics are those of Great Britain, showing how large a number of young women from fifteen to twenty-five years of age succumbed to tuberculosis during the war.

An analysis of most of these statistics shows, however, that certain important facts have been lost sight of and that the conclusions are in many cases erroneous.

Before deciding that women do not do as well, as a sex, in industry we should have comparable data in comparing them with men. Two facts regarding the physical equipment of women should be chiefly considered. The first is that the muscular strength of women is not equal to that of men. There is a tendency to consider muscular strength synonymous with physical health. If a woman fails at a job requiring more foot pounds of energy than she is able to exert, it is her muscles and not her health that is at fault. It is an argument not against the employing of women in industry because of feeble health but an argument for employing them at muscular work suited to their muscular strength.

The second point is that the nervous system of women is usually more responsive, more easily stimulated, than that of men. It is, I think, quite generally held that their sensitivity to stimuli

is somewhat greater than men. This leads to a greater tendency on the part of women to respond to stimuli in times of stress more energetically than their muscular strength will permit and more energetically than is safe for the nervous system of either men or women. Overspeeding and a willingness to work overtime is often the cause of the breakdown in women, whereas I believe that men unconsciously resist such dire influences more effectually. This quality in women is sometimes called conscientiousness. Far be it from me to take away from them any of their spiritual attributes, yet I am sure that conscientiousness is often merely an intensified nervous response which they would be glad to inhibit if they were aware of it or were able to.

In piecework, with an opportunity for more money or promotion by overspeeding and working overtime, women are far more likely to overstep the bounds of health than men. Men working under conditions where there is great opportunity for strain will do better than women. These two facts must always be borne in mind as probably rather permanent sex characteristics.

Finally, we must not fail to take into consideration the fact that after entering industrial life many women are also burdened with the outside work necessary in caring for their homes and their families. We found about 60 per cent with rather heavy outside duties. It is the exception to find a man whose day's work is not practically done when he leaves the factory. When we find one who has domestic duties he is made the pathetic hero of a sob-story. Many of our older women would have done very well at their work had they not had another day's work to do before they had an opportunity to begin recuperating for a new working day. Of course, many of them gradually became more and more fatigued and finally broke down. But this was not the fault of their health nor of their factory work, but of excessive work in the aggregate. The fact that they can stand it at all speaks well for their original health. I doubt if more men would survive it.

When a large number of men fail at a job the work itself is usually considered at fault; when a large number of women

fail, it is usually the sex that is blamed. The natural reaction in the case of men is toward changing the character of the work so that it shall not be a burden. The natural reaction in the case of women would be, provided the premise is correct, that the health of women is at fault. But this is not the usual reaction. The usual one is of giving as much work as possible to men with their supposedly better health. Supposing that part of what the statistics show in regard to the morbidity of women in industry and their failure to get along in factory work is really due to the poorer health of women, why have we not done more generally the obvious thing, try to improve the health of women? I suppose it is because we have quite generally concluded that it was intrinsically at fault and could not be made the equal of men's health. My opinion is that there is nothing intrinsically bad about women's health, that given even the coincident necessity for performing her special physiologic function of childbearing, providing she is laboring at work that is suitable for her lower muscular energy and higher nervous energy, her health can be as reliable as that of men. It seems to me that efforts to protect women in industry should be the same as those to protect men, with the two special considerations already mentioned; and that the chief work should be to promote the health of women who probably need it a little more than men do. Certain ways in which women conduct their lives, certain more or less ingrained habits, have been responsible for the belief that the sex is physically inferior to men. But correction of these habits, in the cases in which I have made the test, have shown that it is possible for women to work day in and day out, month in and month out, not excepting the period of menstruation, only excepting a good interval before and after pregnancy, without showing more wear and tear than a man would. This has been proved by many women in the so-called upper classes who have used their intelligence in forming their habits, but it is not yet very widely proved in the case of those whose habits must be guided by those into whose care they fall.

Two varieties of adaptation will have to be made before industrial life will be satisfactory for either men or women. The first is adaptation of the work to the worker. There is scarcely time to mention this at this time, for it is a subject in itself. The first efforts were made in the direction of shortening the hours of labor. Later it was seen that this is equivalent to giving a smaller dose of a drug that is not agreeing with the patient. It might suffice, but more often it would be necessary to substitute other treatment. This was the case in industry, shortening of the hours not sufficing to reduce greatly the harm done, for example, by excessive temperature, or lead or silicon hazard. But now we have large movements on foot to do a great deal more than shorten hours—in fact, a great deal has already been done. Factory sanitation and occupational hazards are being studied by all sorts of scientists, even by psychologists. All this work is, of course, being done largely from a point of view unconcerned with sex. Conditions as a whole that are safe for men are safe for women, the slightly greater danger to them from certain bad conditions being hardly worth considering. If lead is toxic it is toxic for men and women and the hazard should be done away with for both, even though women suffer a little more from it in their childbearing capacity.

Important as is the adaptation of working conditions to workers, it is an adaptation that will be likely to be made in time—it will have to be worked out by physicians and economists and sociologists and employers and labor unions reasoning together.

The converse of this, on which I especially wish to speak, the adaptation of the worker to the work, is a still greater problem and one less likely to be solved in the near future. Both adaptations will have to be made in connection with women if production and race propagation are to go on apace.

The building up of health so that ordinary work does not result in physical disaster is one of the biggest problems of the time, if not the biggest—although it is overshadowed in the minds of labor organizations by the problem of reducing work to proportions suitable to be done by semi-invalids.

Building up health logically belongs, of course, in the prenatal clinic long before the industrial physician sees the patient. Yet at the time the girls enter the factory there is still much that may be done. Taking the human material supplied and using it wisely by careful placement and good treatment in the factory will do something to reduce the number of industrial failures. But taking this material and molding it into better material is a higher aim and a more fundamental reason for industrial medical work.

Both the mental and the physical state of women as a class and as individuals will have to be studied. There are many aspects of their mental attitude toward their work that lead often to lack of success. Of these I can only mention one—their very common feeling of the transitoriness and relative unimportance of their work. To be sure it does not interfere with their working hard often, for the immediate gain therefrom, but they are less often uplifted and sustained physically by the hopes and plans from the future in the work itself.

Girls even in the lower grades of society often harbor the notion that possibly work may be avoided, and a still more strong desire that it be avoided. Not only in industrial life, but among those who get into business life of any kind, there are many who have prepared themselves only half-heartedly and reluctantly with a lurking suspicion that the work might not be necessary for long and that someone might be found to work for them. "Woman's place is in the home," is the heartfelt belief of most girls, I believe, and it is well that it is so. In spite of all modern feminism, fundamentally women are still guided in unsuspected ways by the creative impulse. It is this that makes them determined, for example, to wear clothing unsuitable for work and hampering them in their work, to mention only one point.

What they need is a conscious redirection of this creative impulse, not out of its original channel but into an additional one. Since work is necessary for them it would be desirable if they could learn to recognize it as another means for utilizing the creative impulse. Even the most humble work might then

be found more satisfying. How to arouse this interest in work as a vital part of their lives I do not know. But it must be done or we shall continue to find the list of those suffering from industrial fatigue swelled by the large numbers of those who are merely bored. From a humanitarian point of view one is as bad as the other.

There are at least a dozen other important problems which psychologists could work on to advantage in connection with industrial work, and I hope the next step after taking doctors into industry will be the addition of psychologists. Much labor trouble would thus be avoided and the problems of physical health be greatly lessened. Physical adaptation of the women to their work is, however, the chief role of the doctor. Its foundation is the physical examination, comprising the initial ones on admission to work, and subsequent ones after the employee has been working at the job for a time.

Examinations were first instituted for the purpose of excluding the unfit. Total rejection is not considered a legitimate aim now, it being thought that each industry should bear its share of defectives and do what it can with them. Only those unfit for any work should be excluded, provided there is sufficient variety of work in the factory to place them anywhere at all. We excluded about 2.4 per cent, largely for pregnancy, total incapacity from recent illness or operation, infectious disease and idiocy (not for moderate degrees of feeblemindedness).

Then another feature was added as an aim for physical examinations since few were to be rejected—those accepted when not in perfect health had to be carefully placed. Among women we found the largest number of girls among the class that were fit only for certain employment when approved for it by the medical department—Class III of the standard classification. Others have found a larger percentage in Class II, fit for any work, but with somewhat impaired health. Fifty per cent of our girls had to be carefully placed. Seventy per cent could be certified for the work for which they were scheduled in the employment office. Girl and management alike profit by this

careful placing, for increased production and better pay result from giving a girl work she can do and not suffer from. A high turnover is the penalty for poor placing. It is, I believe, due to this more than to any one thing.

Later still examinations took on still another meaning. They were extended so as to take cognizance of defects that might be corrected and following them up until they were corrected, after the manner of school examinations. Many industries have dental and eye clinics in the plant, and others provide for the correction of defects, or at all events use all possible influence to have them corrected. We succeeded in getting about 50 per cent of defects corrected, which was rather high considering that the public school, with its greater influence, does not do much better. We were rather surprised to find so many defects still uncorrected even in those who had gone through the schools. But we did find among the younger girls 10 per cent with teeth in which no cavity had ever appeared.

This is an object lesson in what may be done in teaching healthful habits, if one keeps hammering away at them.

The latest aim of physical examinations is to have them serve as a foundation for the upbuilding of the health of the individual examined in other ways than in remedying defects, by the correction of habits that are wrong and the substitution of healthful habits. This entails complete examinations and not mere inspections. Of course, it takes more doctors and costs more money, but the plant that invests its money thus is as sure to reap the reward as is the one that spends its money for the correction of demonstrable defects, for bad hygiene of the individual is equally responsible for high morbidity rates.

We found definite ill-health due to faulty living, and nothing else in a very large number of cases. Functional disease has a very large part in the statistics of industrial illness, although it is not always so recorded. Murmurs are recorded as murmurs, leaving us to consider them organic rather than as weakness of the heart muscle as a part of a general lack of tone of all tissues, due to poor nutrition and poor circulation.

Hyperthyroidism, menstrual disturbances, nervousness, many forms of indigestion and countless other complaints may be traced back to unhealthful living and may be traced forward to organic disease unless the habits are corrected before this unfortunate result. When we first leave the medical school our first question to ourselves after examining a patient is, "What organ is at fault and what is the lesion?" Later, after examining thousands of patients, we are inclined to put it, "What organ is misbehaving and why?" This is an especially appropriate inquiry in regard to the young girls in industry at all events. It is likely to be a functional disturbance, due to the girl's behavior in some way or other. This does not at all mean that it is on that account a minor malady and easily curable. It may be as deeply seated and as ineradicable as mitral regurgitation. Yet the possibilities with functional disease are usually greater, and certainly invite our earnest attention.

The fact that very few of our women over forty-five were free from organic disease and very few at twenty-five free from functional disease lead us to hope that by improvement in the health of the younger ones there might not be so large a number of really ill women at forty-five. Very few of our women at forty-five were able to labor still at the work for which they had been trained at which they could produce the most and earn the most money. Fifty-four out of sixty-four individuals are dependent on friends and relatives at sixty-five, the president of a large insurance company reports. Women are too acquiescent in moderate degrees of poor health. They have not realized that it could be helped perhaps.

The following complaints were far more common than any others, given in order of frequency:

$$\left.\begin{array}{l}\text{Fatigue,}\\ \text{Headache,}\\ \text{Dysmenorrhea,}\\ \text{Indigestion,}\\ \text{Constipation,}\\ \text{Colds.}\end{array}\right\}\text{ various types of each.}$$

Excluding colds, we found that the five other complaints comprised 60 per cent of all complaints. We then found that the one commonest physical defect, poor posture, was usually most marked in the girls who complained of these ailments. The poor posture most commonly found (in 90 per cent of all girls to a greater or less degree) consisted of exaggerated lumbar curve and sagging of the abdomen. The symptoms, in my experience, were seldom referred to the faulty back, at least not in young women, but were most often due to ptosis of the abdominal organs. It is easy to see why many digestive symptoms arose following the sagging of the viscera.

It is also easy to see why menstrual disturbance should arise from the same cause, and I believe it does frequently so arise from the pressure of other viscera from above and the impaired circulation and faulty position of the pelvic viscera.

It is my experience that dysmenorrhea is five times as common among industrial girls as among college girls of the same age and about twice as common among those with markedly poor posture as among those with relatively good posture. These in whom it is entirely absent are usually those with good posture and good nutrition and of healthy, active habits.

My conviction is that natural disturbance due to the menstrual function does not exist. I believe that in a healthy woman it should create not a ripple of mental or physical discomfort. In many factories one day off is allowed a month for the girls to stay at home and suffer in this unnecessary way. I believe the health of the girls would be better if this one day off were allowed when the girl was feeling well in order for her to go out on a hike into the country. The rhythmicity of women and their constantly either experiencing the menstrual period or just getting ready for it or just getting over it, which leaves no time at all for freedom from its complications (a theory given wide publicity by Havelock Ellis and partly corroborated by the unhealthful living of women in past generations), is now, I think, according to the best opinions, an exploded theory.

Menstrual disturbance when it arises is due in 98 per cent

of 2000 cases I examined in some detail to two things—poor posture and the attendant evils mentioned above, and in some cases, about half, more directly to constipation. The impaired position and circulation of the pelvic organs constitute the immediate mechanism in both. The fact that the two causes have this important role has been proved by the correction of these defects, leading in almost every case to either the immediate or ultimate improvement or restoration to normal of the menstrual function.

One of the most successful measures that can be taken among girls is to teach them to stand properly, for almost none of them do it naturally. This is true even of otherwise well-developed, healthy girls. Without special attention to holding the abdomen flat by the use of the abdominal muscles and to keeping the lumbar curve from becoming exaggerated, most girls, if not all, will develop figures something like the letter S. It is even more difficult to teach just now because that type of figure seems to be the style. If it were not for other redeeming features in modern life, such as the general tendency to greater physical activity, the girls would be worse off than ever.

Clothing is not entirely responsible for the posture of women. Corsets simply put the finishing touch on a posture that is already bad. In fact, I think most girls do not put on corsets until the slight bulge of the abdomen attracts their attention to the necessity for concealing this by corsets. The harm is usually already done by the time girls are ten to twelve years old. I believe that it usually begins in round shoulders, the lumbar curve being originally compensatory and the abdominal sagging resulting from that. Posture at school, and to some extent the clothes that small girls wear, are partly responsible for the onset of round shoulders, the stooping aggravated by poor nutrition. Then it is likely to increase rapidly in extent at some time when the musculature is particularly flabby, for example, after an acute infection. Later, pride often results in straightening the shoulders to a certain extent and repeated advice to throw back the shoulders. But the lumbar curve is more commonly neglected.

An increased lumbar curve has been considered natural in women, but all the skeletons in the world might show this characteristic in women, and it would prove to me not that it was natural in women but that it was a very general defect. After the first tendency in this direction has begun a vicious circle is formed, the greater sagging of the abdomen increasing the lumbar curve, and the increasing lumbar curve causing the abdomen to sag more, so that finally we have at least 50 per cent of women with definite visceroptosis.

Fortunately it is usually functional and not structural, and can be greatly improved in girls up to twenty, or even in some cases up to thirty or thirty-five. It is useless to expect much improvement in older women and even in some younger ones. But in all girls under twenty-five who show this defect, particularly if they are complaining of any of the associated symptoms, urgent efforts should be directed toward correcting the defect.

The girl should be stripped and stood in front of a triple mirror, so that every detail of her posture may be well seen, most girls really having no idea of how they carry themselves. It will be an easy matter to demonstrate how far from perfect she is and to show her what the effect of the posture is on her abdominal viscera. She must be shown how to correct it consciously and must be urged to correct it while sitting, standing or walking. Needless to say, her work should be so arranged as to make good posture possible. Further work may be done by small classes in which exercises are taught to give control over the weak abdominal and back muscles. If I could do only one thing for industrial girls it would be to teach them a flat back and a flat abdomen. And this is based on success in getting rid of many common complaints in so doing. Poor appetite, poor nutrition and anemia can often justly be attributed to poor posture. It is probable, too, that the whole symptom-complex based on poor posture plus ill-ventilated lungs may often result in tuberculosis. No industry should be without posture classes.

After posture the next most common physical finding was malnutrition. We did not gauge this entirely by the weight and

height charts. In fact I am rather averse to using these charts too seriously. There are many other factors than malnutrition that determine weight—the size of bones for example. And there are many better signs of malnutrition, at any rate in adults, than underweight according to these charts.

Some of the strongest and finest specimens of women are always a little underweight according to these charts but not according to their own individual standards. About the only time I am much interested in weight is when it is either being lost or gained. If it remains stationary, within reasonable limits, and the health is satisfactory I believe we run more risk in trying to change it than in leaving it where it is. On the contrary, if health is not satisfactory, and if signs of over- or undernutrition exist, adding or substracting a few pounds may accompany the changes that are made in order to improve the health. But the change of weight must be considered as an accompaniment to these other changes and not the chief one to be sought. When we say, "You must gain ten pounds in order to improve your health," we had better say, "You must improve your health by such and such methods," knowing that it will probably result in a gain in weight if such is desirable, but knowing also that it may do nothing of the kind. There seems to be in many a constitutional tendency to weight at a certain level that may not be safely altered a great deal by definite measures attacking weight, only by measures directed toward the general health. If overweight and underweight individuals are not good risks, according to the insurance companies, it is because of what makes the weight so, not on account of the weight itself.

We made definite attempts to improve nutrition by giving advice as to balanced diets and caloric intake, individually as far as possible. We also provided opportunity for extra milk-drinking when necessary. We are all familiar with the peculiar dietaries of young girls when left to themselves. One effort we made was in the direction of providing an abundant supply of vegetables in the plant restaurant, this being the most general lack in home dietaries. Fatigue is always a more serious problem

in the undernourished, and any efforts to improve nutrition will be rewarded by greater ability to stand wear and tear. I believe it is more frequently ignorance rather than poverty that is responsible for poor nutrition.

Apart from malnutrition, we found that dietary indiscretions frequently lead to attacks of indigestion. Monday morning after a Sunday of dietary license, we had many such cases always. From the number of acute and subacute attacks and the amount of chronic indigestion present it would have been natural to conclude that pyloric ulcer and appendicitis were rather common. Yet the disappearence of these symptoms with regulations of the diet seem to point to the fact that either these troubles are curable if treated by hygiene before they have advanced very far, or that the symptoms merely simulated these organic conditions. However it may be, the entire disappearance of the symptoms frequently followed better diet and better posture, which was the source of a mixture of gladness and sorrow in one who was on the lookout for surgery.

Constipation was so frequently associated with the various digestive complaints that we made a definite attack upon it. The measures we advocated most generally were:

Drinking ten glasses of water a day.

Eating mechanically stimulating food.

Eating chemically active food.

Eating enough but not too much.

Eating regularly and slowly.

Strengthening the abdominal muscles and improving the abdominal circulation by exercise and massage of abdomen.

Making an effort to empty the bowel within five minutes after each meal.

Using a foot-stool if the toilet seat is too high.

Taking outdoor exercises of some kind ever day.

We, of course, used cathartics while giving the hygienic measures an opportunity to produce results. The combination of these measures can hardly fail ultimately to make the giving up of cathartics possible, except in the really pathologic cases, in which

case they would possibly have to be relied upon. In many cases just one of these measures alone proved effective—for example, water-drinking.

There are many ways in which the health of the girls may be promoted. All of them together will have much effect on the commonest complaint of all—fatigue. There are many ways in which work may be made less fatiguing, but there are many ways in which girls may be made less easily fatigued. We should endeavor to establish certain standards of personal hygiene, as we do of factory hygiene, and seek to have workers live up to them.

At first it is sometimes difficult to make girls take advice instead of medicine, and sometimes we have to use both in order to make either effective. But we should teach them to consider advice when coming from the doctor as valuable as pills, either being given according to the circumstances.

First we will have to learn the value of such advice ourselves by giving it with discrimination, seeing that it is applied and checking up the results. Most of us have too little faith in the ability of individuals to change their habits and in the result that will be attained thereby. Without at all minimizing drugs we must admit that they would seldom be necessary if people would live normally.

In conclusion, we must try now at the beginning of an age of women in factories to make the desirable adjustments of both women to the work and the work to women, for there is much work they may do without suffering from it if all the conditions are satisfactory. Work they must if production is to go on, and work they should if they are to be happy. Work offers them the same opportunity it does us of accomplishing something worth while in the world. But, of course, it ought not to be done at the sacrifice of the ability to be comfortable and happy in their leisure nor at the cost of broken-down health and early death. Especially should it not be done at the cost of their function as mothers. With suitable adaptations of both work and women, none of these heavy costs will have to be paid. It

is the failure to make these adaptations rather than the inherent poor health of women that is responsible for their present somewhat unfavorable position in the industrial statistics. And the heaviest portion of this adaptation, building health, is the function of the industrial physician.

DISCUSSION

Dr. Rachel R. Williams: In speaking of fatigue, in industry, the social economic causes should be stressed big; domestic difficulties in the home and financial situations where the income is inadequate; a hustling, driving, business head with little sympathy or imagination may be a fretful cause; the practical application of the laws of health is little understood or practised.

The industrial physician should therefore educate his or her people by means of articles in the store-paper, lectures and individual talks on the needs of the human body.

Too many people are like the man who said that he did not know that he was studying about himself when he studied physiology.

Is the woman whose breakfast consists of eight or nine cups of coffee proof against fatigue?

Exercise is vital, but how can we recommend it to the woman who at the end of a day's work goes home to take up the duties there?

A good *posture* is important, but impossible with the high-heeled pumps which our girls wear to business. And the fatigue which accompanies aching backs and feet, who can measure! The waitress in a restaurant wearing a pair of cheap shoes, broken through in both arches, complains that she has rheumatism in her feet. These few illustrations show the need of education in body conservation. Our people wish to be freed from pain, not to seek the cause and eliminate it, which can often be done by rooting out bad habits and establishing correct ones.

APRIL 29

Some Remarks on Fatigue in Industry

BY SIDNEY J. REPPLIER, M.D.

The question of the length of the working day is a scientific rather than an economic one. This paper is not an effort to

solve the problem of its proper length but a presentation of some facts bearing on it. The point at issue is not whether a nine- or a ten-hour working day will result in greater productivity than an eight-hour day, but rather to find the boundary line between normal physiologic fatigue and abnormal over-fatigue. In order to explain our meaning more fully, let us define fatigue and investigate the results of overfatigue.

Fatigue, whether normal or abnormal, is the result of an accumulation of waste products in the system following some form of activity of the human organism. There are two processes constantly at work, a building up or anabolism and a pulling down or katabolism. Katabolism is relatively much more active during working hours; anabolism during rest hours. At the end of the twenty-four-hour cycle the balance should be slightly in favor of the anabolic processes, or at least not in favor of the katabolic ones. If the latter is true we are exactly in the position of the man who is spending more than he earns. As soon as our reserves are exhausted health bankruptcy is upon us.

The sense of fatigue is Nature's warning that the boundary line between the normal and the abnormal accumulation of waste products is being approached. If this warning is disregarded either from choice or necessity the fatigue state ceases to be physiologic and becomes pathologic; in other words, the waste products cannot be entirely eliminated nor the wear and tear entirely repaired in the time that the anabolic processes have at their disposal and when this continues day after day and month after month the result can easily be imagined.

Three parts of the animal mechanism are affected by overexertion, the muscles, the nerves and the central nervous system. Collis and Greenwood, in their book *The Health of the Industrial Worker*, quote authorities to the effect that the central nervous system feels the effects of fatigue first, the nerve end-organs second and the muscles themselves last. The effect of activity on the nerves is so slight that for practical purposes it may be neglected. If this conclusion is correct the muscles which perform the external work are protected from complete exhaustion,

first, by failure of the central nervous system to transmit impulses, and, second, by the inability of the nerve end-organs, located in the muscles, to receive them. They conclude that . . . a minimal impulse is required to make a muscle contract at all, and the sum of a number of minimal or medium impulses which result in but a small foot-poundage of work may be more fatiguing to the central nervous system than a few impulses followed by a larger output of energy. The conclusions follow that: "(1) The number of impulses originated as well as their size determine the onset of fatigue: that is to say, rapidity of movement is important as well as the amount of work done. (2) Industrial fatigue is essentially a problem of the central nervous system."

An understanding of these facts will help in comprehending how mental fatigue enters into many industrial processes. These same authors quote C. S. Myers, who says in his book *Industrial Overstrain and Unrest:* "In monotonous mental work a similar protective function can be seen. When we are engaged on any one piece of mental work other mental processes are inhibited which are incompatible with it; but the effects of fatigue are safeguarded by the gradual failure of these processes of inhibition. The inhibited mental processes sooner or later refuse to be suppressed. Other mental activities accordingly intrude and by their inhibitory action make the continuance of monotonous mental work impossible. . . . Higher control is actually fatigued and cannot be immediately employed for concentration in another direction, for the synopses concerned in the effort of inhibition are most sensitive to fatigue, and this fatigue enters into and affects other subsequent self-effort.

"We conclude, then, that monotonous application for long hours at relatively light work induces an incapacity as serious as employment for shorter hours at more strenuous work. Indeed, the incapacity may be more serious, *e. g.*, when the lighter work is mainly of a mental character, watching and controlling a small piece of machinery that does everlastingly the same job—and when the heavier work is mainly of a mechanical character, *e. g.*, lifting huge weights of iron. In the latter case the main source

of fatigue arises, as we have seen, from the accumulation of waste products in the muscles, and especially from the nervous inhibitory processes arising from unchanging muscular exercise. But such nervous inhibition has its seat in far lower and less important nerve centers than in the former case. The volitional efforts made to overcome such muscular incapacity are much less effective and less baneful than those made to overcome the boredom and weariness arising from mental work. Hence the pathologic expression of continued fatigue, *i. e.*, overstrain, is far less prevalent in muscular than in mental exertion."

In 1865 the physiologist Ranke showed that if an extract of fatigued frog muscle was injected into a second frog the muscles of the second animal showed evidences of fatigue. The source of muscular fatigue can be shown by von Helmholtz's myograph to be the toxins produced in the muscles during work. This test is carried on with an isolated muscle, and after fatigue has set in the muscle can be again stimulated to contract by flushing out the bloodvessels with salt solution, thus washing away the fatigue products.

Following the lead of von Helmholtz, Mosso constructed the ergograph, which records the contractions of a single muscle or group of muscles in living subjects. He has conducted a series of experiments at Turin, Italy, by which our knowledge of fatigue in living human beings has been greatly widened. He has shown, among other things, that if sufficient rests are taken between muscular efforts, a rest of ten seconds, for example, between contractions of the flexor muscles of the finger lifting a load of 6 kg., no fatigue results. On the other hand, once the muscle is exhausted by being worked without rest, it required two hours for the muscle to make a complete recovery. It has been deduced from this long period of necessary rest that another factor than accumulated waste products is concerned in producing fatigue. This other factor is the actual consumption of energy-yielding substances when katabolism exceeds anabolism, with the result that replacement of this deficient material must follow before recovery is complete. A review of the chemistry of muscular

action will make this clear. The carbohydrates are the elements of the food most directly concerned with producing muscular energy. These pass through various stages and finally go directly to the muscles as glycogen, any excess being stored in the liver. When muscular activity occurs the glycogen combines with the oxygen of the loose oxyhemoglobin mixture, setting free the hemoglobin. The result of this combination is the oxygenation of the glycogen with the production of energy and the liberation of carbon dioxide and certain acids which are the waste products of this combustion. When the body's supply of glycogen is entirely used up, as a result of too rapid or too prolonged combustion, it is evident that return of function of the muscle depends not only on the removal of waste products but also on the storing up of a fresh supply of glycogen.

Treves, one of the Mosso school at Turin, has made some researches which throw further light on the ill-effects of excessive demands on nervous energy. He has shown the "staircase" or "treppe" character of the curve of fatigue, indicating a marked gain in efficiency during the first period of work. After the height of the curve is reached it continues for a time at its maximum until the onset of fatigue causes it to fall. By means of training and practice the "staircase" feature of the curve can be made higher and the maximum prolonged over a longer period. It does this by retarding the onset of fatigue through making the tissues more resistant to its toxins.

The question here arises, as Treves points out, whether, in intensive regular labor which makes great demands on the organism, muscular efficiency may not be bought at too dear a cost of nervous energy. He says: "According to my experience it has not been found that training has as favorable an effect upon energy as upon muscular strength. . . and this fact teaches, also, the practical necessity of preventing women, children and even adult men from becoming subjected to labor which, indeed, a gradual muscular training may make possible, but at the price of an excessive loss of nervous energy which is not betrayed by any obvious or immediate symptoms, either objective or sub-

jective. While the individual works the reserves of disposable nervous energy in the neurons which preside over muscles diminish much more rapidily than the production of work which may keep to the normal level. . . . In spite of this diminution, if circumstances continually demand intense and constant work, the stimulus will continue to be sent to the muscle with the intensity necessary to accomplish this purpose. . . .

"Here we have an arrangement of things which is of inestimable value to man in the production of work; but this beneficent provision becomes injurious to the dynamic equilibrium of the organism as soon as it is irrationally employed. It is this that needs to be avoided in the practical organization of industry."

Josephine Goldmark, in her book *Fatigue and Efficiency*, sums up the questions so far considered as follows: "At this point the scientific interpretation of industrial problems. . . becomes obvious enough. A flood of light is thrown upon the intricate injuries of speed, overtime, piece-work and like industrial requirements; for if fatigue be due to demonstrated chemical action, removable only by proper intervals of rest; if over-fatigue or exhaustion results from the accumulation of chemical fatigue products and the destruction of energy-yielding material in nerve and muscle tissue; if strain or labor carried on after fatigue has set in is proved more exhausting than simple work, and if muscular training outruns nervous strength, then the need for the shorter work-day rests upon a scientific basis. Science makes out its case for the short day in industry."

The features of industrial activity which make the greatest demand on human energies, and which therefor are most likely to produce abnormal fatigue, are, according to Goldmark, speed and complexity, monotony, piece-work and overtime. To these may be added noise and improper mechanical rhythm. It is not my purpose to do more than simply mention these here. Discussion of these points would involve considerably more time than could be given in a paper of this kind. It can hardly be denied, however, that each of these factors could play an important part in the production of over-fatigue.

Objection may be raised that the degree of normal or abnormal fatigue may not be entirely due to the character of the work. Outside influences over which the industry has no control may affect very decidedly the worker's energy. Collis and Greenwood state that in investigating the subject of industrial activity and fatigue both outside and inside contributory influences must be considered. Such outside influences are housing conditions, transit conditions and personal habits and forms of recreation of the workers. Contributory influences during the period of employement are hours of work, conditions of labor and methods of work. Any attempt at measurement of the degree of fatigue in industrial work must take all these factors into consideration. Where, for example, comparisons are made between the effect of the eight- and nine-hour day care should be taken that these contributory influences should be as nearly alike as possible.

There are two ways of measuring the degree of fatigue, the direct and the indirect. The direct test should be capable of indicating at any moment the presence in any worker of a diminished capacity for doing work. If such test could be devised which would command general acceptance and not be open to objection it would be an immense help to the study of fatigue. Ryan has suggested a vascular skin reaction; Martin and Lovett have applied a muscular strength test to workers; a third test attempts to coördinate pulse-rate and respiratory effort. But none has yet met with very general favor or approval.

The usual way of measuring the degree of fatigue is by the indirect method, *i. e.*, by means of output, lost time and sickness, and by the amount of labor turnover. The advantages of this method are that it can be carried on without the knowledge of the workers and that records of this kind are usually kept for business purposes and are therefore readily available.

Let us examine somewhat more in detail the inside contributory influences, continuing to bear in mind, however, the fact that external influences must never be lost sight of in reaching a conclusion. Probably the most important of these is hours of labor. In this connection Collis and Greenwood say: "The idea that

if a worker can make 100 articles in 1 hour he ought to make 1000 in 10 hours . . . is seen to be as foolish as to expect a runner who can sprint 100 yards in 10 seconds to cover a mile in 176 seconds; and the dictum of the Manchester School of Industrial Economists in the middle of the last century that 'it is in the last hour of work that profits are made' (without any regard to the number of hours previously worked) is now countered by the truth that 'overtime does not pay.' In many cases the shortening of hours has resulted in an increase in total output because there is a longer interval for the removal from the tissues of fatigue products and for the building up of fresh energy."

They point to the classic instance of the shortening of hours from 53 to 48 per week which took place in 1893-94 in the works of Mather & Pratt at Salford, England. These results showed (*a*) that there was an increase of 0.4 per cent in the ratio of the wage cost to turnover; (*b*) that there was a saving in gas, electricity, fuel, wear and tear amounting also to 0.4 per cent; (*c*) that there was a fall in the amount of lost time from 2.46 per cent to 0.46 per cent; (*d*) that though piece-workers lost 1.76 per cent at the beginning of the trial year this fell to 0.78 per cent at the end; and (*e*) that there was "increased cheerfulness and brightness" on the part of the workers. Sir William Mather wrote in 1894 at the end of the trial year: "We seem to have been working in harmony with natural law instead of against it . . . Of this I am assured, that the most economic production is obtained by employing men only so long as they are at their best; when this stage is passed there is no true economy in their continued work."

As a result of the success of the Salford experiment the British Government was induced to put the forty-eight-hour week into operation in the Woolwich Arsenal Works with its 43,000 employees. It has worked equally well there.

The experience of the Engis Chemical Works, near Liège, Belgium, is also illuminating. They changed from a two-shift to a three-shift system without any reduction in wages or decrease in the individual productivity of the workmen. The overhead fell 33⅓ per cent and the total cost of production fell 20 per cent.

In 1900, Ernst Abbé, the head of the Zeiss Optical Works at Jena, changed from a nine-hour day to an eight-hour day. For a period of one year he kept careful tabulation of the amount of wages earned and the rate of production. He found that there was a substantial increase in both.

The second of the inside contributory influences are the conditions of labor. It is not necessary to discuss these in detail except to say that the most important of these are proper ventilation, correct temperature and good lighting. The effect of these upon the health of the workers is self-evident.

The third of these inside contributory influences is methods of work. Of late years the studies of Frederick Taylor along these lines have aroused much discussion and have been the object of much criticism both for and against. Wonderful results have undoubtedly been obtained by the Taylor system, but it has not been universally popular with the workers. This does not necessarily argue against the merits of the system but rather against the way it has been applied and exploited by some not too scrupulous employers. His experiments at the Bethlehem Steel Works, where, in loading pig iron, a man's output increased from $12\frac{1}{2}$ tons to 17 tons and his rate of pay advanced from $1.15 to $1.85 per day, seem to show that it is successful when properly applied.

It can hardly be denied that the length of the work day, the conditions of employment and the methods of work all have an important bearing on the question of fatigue. All of these can be made the subject of legislation, especially the length of the work day, and can be regulated according to the consensus of opinion of the state. The outside influences are much more matters of individual expression and do not lend themselves so readily to legislative regulation. To many students of the subject the proper course is to regulate by law those influences which can be easily reached and to trust to education and a higher standard of living to bring about the necessary improvements in unsanitary conditions which may exist in the homes and habits of the workers themselves.

APRIL 29, 1921

Occupational Outbreaks of the Skin, Including Novocain Eruptions

BY FRANK CROZER KNOWLES, M.D.

AND

EDWARD FOULKE CORSON, M.D.

Eczema, or dermatitis, comprises a large number of all cases of diseases of the skin. There were observed from the years 1902–1912, 24,459 dermatologic cases, and of this number 4142 were classed as eczema or dermatitis.[1] In a paper read before the American Dermatological Association in 1912[2] the external origin of eczema, or dermatitis, was discussed at length, and it was determined that one-fourth of these cases is of external origin and almost one-sixth is caused by the trade of the individual.

Irritants causing an outbreak on the skin are almost innumerable, and therefore it has been decided best to select only a few instances from our hospital dispensaries and private practice. During the last two months (February and March, 1921), out of 228 new cases coming for treatment to the Skin Dispensary of the Jefferson Hospital, 12 were well-marked examples of trade dermatitis. The occupations represented in this number were as follows: fisherman, cooper, fruit-dealer, cloth-cutter, fumigator, tailor, manufacturing jeweler, printer, machinist, driver, bronze-worker and candy-maker. During the same period two dentists employing novocain and four women using hair dyes have been under observation in private practice.

The hands, as would be expected of the portions of the body coming most intimately into contact with the various agencies employed in the several trades, were involved in all the hospital cases. Indeed, with the exception of the fumigator and the bronze worker they were the only regions affected among the twelve in that group.

According to R. Prosser White: "The 'catchment points' of the skin's surface are its stomata and the hollows between the ridges. This proposition is quite obvious if the agent is black, such as soot, or darkened by dirt or impurities, such as petroleum." The same writer called attention to the fact that workers who sweat profusely were much more liable to trade dermatoses than those who perspired less freely. This has been our own observation. Perspiration collects the dust, fumes or other form or irritant, retains it in contact with the skin, and oftentimes, by dissolving it, makes its action more severe.

The hands, besides being the most exposed portion of the body, afford many special "catchment points," as the webs of the fingers, around the nails and the furrows and creases of each of the numerous small joints of those parts, in addition to the pores, hairs and furrows common to most skin surfaces. Unless special attention is given to rigid cleanliness this material is apt to leave traces which later may irritate or, indeed, the measures taken to remove the stains themselves prove the exciting cause of an outbreak. The right hand, obviously, is usually worse than the left, even when both are engaged in the same work. Occasionally the functions of the two members differ, as was noted in two of our cases, the printer and the cutter, where each hand suffered from a separate cause.

The fumigator over an extended period of time had been employed in liberating formaldehyde vapors. For several years his skin withstood the action of the fumes, but finally became irritated and showed a generalized erythematosquamous and vesicular eruption. This repeatedly disappeared following treatment and recurred when he resumed his work as a disinfector. The bronze-worker exhibited a vesicular outbreak on the face, hands and forearms, both regions exposed to acid fumes in the foundry, where he was accustomed to keep his sleeves rolled up. The dentists showed a decided inflammation of the hands and fingers, particularly the third and fourth fingers of the right hand and the index finger and the thumb of the left hand. There was marked vesiculation and pustulation, fissuring, oozing,

crusting and redness. This eruption was apparently due to novocain, as other irritants seemed to have been excluded. With the syringe held in the right hand any leakage ran down on the lower fingers of that hand, while the left thumb and index finger were close to the field being anesthetized and liable to be in contact with the solution used. The four women using the hair dye showed a marked edematous redness, extending down the face from the hair line, with closure of the eyelids by swelling. The outbreak was mostly dry, although there was some slight vesiculation. Later in the outbreak the skin was red and scaly. The itching was intolerable and quite persistent. In some of these cases the eruption and itching continued over many weeks.

There is no one who has written more completely on the subject of "Occupational Affections of the Skin" than R. Prosser White, and the exact irritant provocative of an outbreak in the present cases will be largely gleaned from his excellent book. Alkalies, and especially caustic alkalies, have a rapid and most deleterious action upon the skin. The strong solution of caustic soda used by coopers in "barrel-washing" was evidently the cause of outbreak in one of our cases. The eruption occurring in fruit-dealers apparently is caused by the essential oil which exudes from cutting the rind of oranges. Our patient frequently had his hands wet with the juice of citrus fruits. Outbreaks occurring among those handling fish are usually due to the salt in the "fish-curing" industry. The greater the concentration of the brine the more irritation is produced. The eruption in our case was evidently produced by the irritation of the fish scales, the lines and the prolonged immersion of the hands in cold water, as the patient was not a "pickler." Potassium cyanide used for the cleansing of silver, gold and less precious metals, and quick "rouge," a red powder containing ferric oxide and mercury, employed for "dry polishing," were undoubtedly causal in two of our cases.

The cases observed in trades dealing with cloth-handling, one in a tailor and the other in a cutter, would suggest that the mordants or other chemicals still remaining in the cloth were to blame. The latter worker exhibited on the fingers an itchy,

vesicular and erythematosquamous outbreak. In addition, a scaly, reddened patch ran diagonally across the palm of his right hand, corresponding to the region pressed by the shears when at his work. The eruptions occurring in candy-workers may develop from an inferior quality of sugar in which is an acarus. The old-fashioned brown sugar was apparently more apt to cause an outbreak than those doubly refined. Sugar is frequently a cause of eczema in those who handle it largely, mainly grocers, candy-workers, pastry-cooks, etc. Our patient handled an inferior grade of candy in a confectioner's shop. She developed the outbreak after a month's employment at this work. On changing her form of occupation she was much improved.

It is rather difficult to come to a conclusion as to the special irritant causing an outbreak in the mechanical trades as to whether a high grade of petroleum oil or the cheap oils, such as heavy coal-tar, shale or refuse, where these are employed. The outbreak occurring on the hands and forearms of mechanics is undoubtedly of local origin. Dirty lubricating oil full of sediment and impurities as encountered in automobile crank cases by repair men is more irritating than the clean stock. Also the various agents used to remove grease from the hands, containing as they usually do free alkali and grit, are quite apt to be badly tolerated by the skin. The driver of a delivery wagon used brass polish and cleaned the harness with a soapy preparation. His hands were the seat of a red, scaly, itchy outbreak, especially marked on the fingers. Oozing and vesiculation were occasionally present. The printer used a hand press. His left hand bore a stigma characteristic of his work—a heavily calloused ridge across the palm and two fingers where he grasped the wheel. His right hand showed a vesicular eruption, largely limited to the fingers, the nails of which were rimmed with ink. The ink was daily cleaned off with benzine, following which a soft soap with grit and free alkali was thoroughly rubbed in and washed off.

An interesting account of novocain dermatitis is described by Guptill. In this personal example the writer's hands became highly irritated, chapped, cracked and at times badly swollen,

especially the third and fourth fingers of the right hand. Later the face and lips became swollen. There was vesiculation and a considerable number of pustules, much crusting and intolerable itching. The eruption on the face was thought to have been caused by the bursting of air bubbles as they were expelled from the syringe held up close to the face. Others[3] have reported somewhat similar types of eruption in dentists using procain and apothesin.

Although various irritants used in scalp preparations and hair dyes may be causal of a dermatitis, the hydrochlorate of paraphenylene diamin is particularly to blame.[4] This chemical under the influence of oxygen is converted into quinone. This property has led to its being used as a hair dye, as tints from auburn to jet black may be produced. An aqueous or alcoholic solution of the diamin is first brushed or sponged on and a few seconds later oxygenated water is similarly applied with immediate effect. Quinone gives off most irritating vapors which cause the outbreak.

Pusey has likened the differential diagnosis of eczema and dermatitis to that difference which exists between natural and artificial ice. Some few points help to a slight degree in distinguishing the externally produced eruption. The history of a trade commonly producing such a condition, a pruritus more intense than ordinary, the grouping and location involved, a sudden onset, sharper outline and more rapid course—all are suggestive. The initial type of lesion is apt to be retained throughout and careful observation early in the case may note a beginning in any spread from "catchment points."

This brief paper points out the relatively common occurrence among skin diseases of eruptions caused by occupational hazards. Selecting, as we have done, the new cases coming to a dispensary over a short period of time, we found over 5 per cent of the patients to be included in this class. Our few cases exhibited an unusually wide diversity of trades and consequently an equal variety of special irritants. The exact agent responsible for the eruption in a given case is sometimes difficult to distinguish and a knowl-

edge of working conditions in the trade involved is essential both for diagnosis and treatment.

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DISCUSSION

Dr. Henry Kennedy Gaskill: Nearly every patient who comes to us with a trade dermatitis makes the statement that he cannot understand why this eruption should have occurred, as he has been following the same line of work as he has always been pursuing for years. This may be true, but one of many constitutional factors may have been altered or there may have been some change in environment: for instance, he may have been working where there is an increased amount of dust and dirt, improper ventilation or heating, or the fumes of chemicals of various kinds may have produced a susceptibility of the skin to irritation. Cardiovascular derangement may be of such gravity as to be of grave significance. Changes in conditions affecting the sweat-glands, either producing an excessive exudation or a diminished amount, thereby throwing the work on the kidneys, is a very important factor, as may be change in the quantity and quality of the secretion from the sebaceous glands. Gastrointestinal disturbances, particularly constipation, are of considerable importance. Age, of course, must be taken into consideration, the younger person with a more delicate skin being much more susceptible than those who are older with time-hardened and weather-beaten skins. These factors may be very difficult to ascertain, and it is only after the most diligent search that we are able to locate them, and which, if corrected, will often prevent a recurrence.

In a considerable number of these dermatoses the initial treatment has been of too radical a nature. It is always well to remember that mild, soothing remedies should be applied to irritated, inflamed skin surfaces. If there is induration and a moderate amount of inflammation, then the stronger remedies are indicated; but it is always well in these cases to err on the safe side and work up gradually to these latter remedies.

Tanners and those working in and with chemicals are particularly liable to skin irritation. Several years ago Dr. J. Chalmers Da Costa, in an article on "Tanners' Ulcer," recommended the use of an ointment for those working in such trades. It consisted as follows:

"Three parts of petrolatum are mixed with one part of lanolin. This mixture is melted on a water-bath or stove, and when melted and thoroughly mixed, 10 to 15 drops of 90 per cent carbolic acid are added to every 400 gm. of the mixture. This represents 5 drops of acid to 4 gm. of ointment. The material is placed in a glass or earthenware jar and allowed to solidify until ready for use. The workman cleanses his hands and arms thoroughly with soap and water, rinses with warm water, and while the parts are still moist, applies the ointment. He rubs it over the whole exposed area for about two or three minutes. He then takes a clean cloth and wipes the skin entirely dry."

I have recommended the use of this preparation many times and found it most efficacious.

As an example of trade dermatitis that may affect other persons than those who actually work in it may be cited the following: During the war and since several cases were reported among men of an eruption occurring on the upper anterior thigh, sharply circumscribed and accompanied with intense itching. After careful investigation this was found to be due to an irritation caused by the match-box which a man usually carries in his trousers pocket, and which was, probably, produced by the irritating action of sesquisulphide of phosphorus, this being one of the ingredients used on the striking surface of match-boxes, and which caused so much suffering among the workers that it was discontinued.

Dr. Knowles has spoken of a dermatitis occurring among dentists from the use of novocain. This can hardly be classed under the head of this discussion, but it is in the true sense of the meaning a trade dermatitis. I have recently seen a dentist suffering from using this drug and one from the use of procain, an allied product. Several cases have also been reported in the literature.

In closing, I can only reiterate: Mild remedies for acutely inflammatory trade dermatoses, reserving stronger stimulating remedies for sluggish indurated conditions.

DECEMBER 16, 1921

A Plan of Industrial Clinics for Philadelphia

BY MIRVYN ROSS TAYLOR, M.D.

Physicians engaged in the work of "Health Supervision in Industry" cannot long continue their efforts without coming

to a realization of the tremendous economic value accrued from efficient health and accident prevention and from the early and proper treatment of wounds and injuries. But what is going on along these lines in one plant is not what is occurring in other plants not equipped with an efficient medical department.

If one studies the conditions existing he will soon find a condition of affairs pernicious to both employee and employer alike which are the following:

That there is an excessive and unnecessarily large number of cases of septic infection and maladjustments in the case of accidents occurring in industry. After-effects from these causes not uncommonly turn the comparatively minor injuries into permanent mutilations or serious cases for compensation under the Pennsylvania State Compensation Law; such results also either permanently reduce the earning capacity of the worker affected or at least keep him out of work for a longer period than should be required; and, as a rule, excess absence from industry or the lessening of earning power causes more or less direct loss in production to the industry operation.

That there is much sickness of a vocational character, or caused by hygienic conditions in plants, which, through lack of a fully adequate system of attention, results in losses to workers and employers through unncessary absences from work and reduced vitality and capacity.

That the general hospitals cannot, for reasons later to be discussed, treat satisfactorily all types of injuries occurring in industry, nor can they give to industries advice upon sanitary conditions of the workplace and proper supervision of the individual worker, thus enabling the employer to avoid placing him upon work for which he is not physically fitted.

That there is a disposition on the part of the employer not to furnish adequate medical and surgical attention to injured employees and to shift their obligations to the insurance carriers.

We find that industrial physicians are generally dissatisfied with the hospital service available for cases originating in industries and business concerns and have the impression that the

services provided for by the hospitals is somewhat inadequate and too impersonal. The dissatisfaction is due to the existence of a number of conditions, for example: certain employees become incapacitated through injury or disease, and failure to return these men to the industries as soon as possible involves appreciable losses on the part of the industry.

The hospital surgeon, in dealing with injury, is apt to only regard the technical surgical problems involved and the ultimate perfect result. The time element does not enter as strongly as it should into his treatment.

The plant owners and the industrial physicans would like to obtain the finest surgical and medical attention available, but under the present system of hospitals such service is not possible because of the great pressure of work under which the hospital physicians are laboring, and they feel that they cannot in justice to themselves and to their hospitals devote a disproportionate amount of attention and time to cases originating in industries merely because of this fact.

Furthermore, the industrial physicians of the larger plants and the managers of the smaller plants which have no industrial medicine departments are frequently at a loss to know to which doctors of the various hospitals to refer certain types of cases, since no definite information is available on this subject. Further, because of the shifting service in the accident wards, emergency rooms and dispensaries the industrial sickness and accident cases are often treated by different doctors at each visit, which is most unsatisfactory.

Moreover, there are thousands of workers in industries who are hampered by reason of physical defects, most of which are correctable, but when allowed to exist seriously affect their efficiency and may increase their liability to accidents.

General hospitals show a reluctance to furnish industrial physicians with adequate reports of cases, thus hampering the physicians in making out their reports to benefit fund committees in sickness and accident disabilities.

It is not my intention in any way to discredit the efficiency

and public good which the general hospitals are doing, but only in so far as they apply directly to industry, in which case they do not meet the exacting modern industrial medical requirment in all its ramifications.

Evidence is sufficient to indicate clearly that great improvement can be made with regard to medical attention in industry with resultant material and financial saving to the employers and workers of Philadelphia. A concrete illustration of the possibilities is to be found in the case of one of our Philadelphia manufacturing plants, which employs approximately 2000 workers. This plant and its operation are classified as an industry containing a reasonably large accident hazard. The establishment has developed a thoroughly competent and well-organized clinic for dealing with accident and sickness cases. As a result of the care given not only in the safety field, but by the attention given to the accidents which have occurred, there have been no compensable cases in the establishment for over ten months. It is recognized that in the present time of industrial depression and comparatively small payrolls percentages of accidents are apt to be low, but a record of this kind would be practically impossible without the use of such an industrial medical organization as has been established at this plant.

I am confident that a practical plan can be worked out which will effectively reduce the losses caused by accidents and injury of health occurring in the workplaces, and that such a plan must include the following items:

1. Carefully trained and intelligent first-aid organizations available to all the industrial workers of the city.

2. Consistent and well-directed treatment of cases of sickness occurring in workplaces.

3. Careful diagnosis, study and treatment of cases of sickness occurring in workplaces.

4. Proper supervision of hygienic conditions of the workplace.

5. Knowledge concerning the individual worker which will enable the employer to avoid placing him upon work to which he is not physically fitted.

To these items should be added also the necessity of having a medical staff handling the situation which will fully recognize the necessity of minimum absence from employment and maximum physical capacity and energy.

At the present time in the city of Philadelphia there is a limited number of our larger industrial establishments which have the medical organizations, personnel and facilities required to handle the problem herein dealt with effectively, but in many cases, even in these establishments, the limited number of employees makes the support of such facilities relatively expensive. The great mass of the employers of the city, however, have such a small enrollment of workers as to make the erection of suitable industrial clinics or medical organizations in their plants entirely impracticable. The situation, then, is that many of the workers are not given the care which, for the financial and health benefit of all, should be universally available throughout industry.

In order to rectify the situation, and having studied the problem from every angle, we have agreed that a system of clinics should be established, each to serve a given industrial zone or district in the city and equipped with a proper medical staff and other facilities, the services of which would be available to all industrial establishments in their respective districts. To this may be added a central clinic or organization for general supervisory purposes and to deal with cases of particular gravity. This central organization, among other things, should be so equipped as to be able to practice the methods of group medicine and to study vocational conditions with regard to health and the treatments best applicable to those sustaining industrial injuries, including first-aid.

Available quarters for the zone clinic might be housed in a hospital or manufacturing plant already equipped with a medical department and the central clinic might be located in an existing hospital. The medical staff organization of the industrial clinic to act separately and distinct from the regular attending staff of the hospital, thus only utilizing equipment and occupying space. I am quite sure that from both a professional as well as

a financial standpoint a mutually satisfactory arrangement could be reached and the institutions benefited by such an arrangement.

The agents of these organizations should perform the following functions:

1. Visit all the workplaces in their districts and give training in first-aid.

2. Give directions for necessary treatment in cases requiring more than first-aid measures.

3. Advise with employers with regard to hygienic and health conditions in the workplace.

4. Diagnose cases of sickness occurring in the workplace.

5. Make a study of vocational sickness for the purpose of devising methods for eliminating the causes.

6. By individual examinations when necessary, and advise as to the best method of preventing injuries occurring from misplacement of workers.

All of this work should be carried on not only with a view to conserve the health of the workers but also to prevent as much loss of time or capacity as is possible. It will be noticed that these organizations must be in intimate contact and relationship with the industrial establishments.

By having such a system of industrial clinics the whole plane of industrial practice would be raised, for none have a better opportunity of applying the ideals of preventive medicine than the industrial physicians studying as he does physically as well as sociologically the masses of wage-earners. By such close supervision he can give them their capital, health, which will be maintained intact and will redound by ensuring scientific and adequate consideration and handling of one of the major problems of the health of the city. It will provide for efficient coöperation with all the existing health societies and organizations and will render available concrete, scientific information along lines not yet touched upon from the viewpoint of an industrial etiology.

Also, by having such a system, the industry and the employee alike would benefit by the advice and corrective treatment, for

the immediate results in the improvement in the health of a body of workers are shown in the elimination of the employer's losses which come from such causes and which causes are obvious when we realize the vicious circle of cause and effect; and, further, when we consider the effect of ill-health on the quantity of production, ill-health and its effect on the quality of production, ill-health and its relationship to ill-will and ill-health and financial loss to the employer. The whole scheme would give to all industries alike the advantage that a few now enjoy, "health supervision," and place within reach of all workers the means of obtaining the best surgical treatment available and a means of exhaustive study and diagnosis in medical conditions which the average employee cannot afford to obtain now, unless he wishes to accept it as charity. In this scheme the employee would be made to feel that he is not a recipient of charity but that it is a service carried on for the benefit of his employer as much as for himself.

Not only would there be savings through such a system of the character named heretofore, but under the accident compensation laws of Pennsylvania a well-worked-out system of this character would result in a reduction of accident insurance premiums. It is believed that the actual money spent to maintain the system would be many times repaid to the industries of Philadelphia through the various economies in human energies thereby obtained.

The development of a system of this character is not in any sense intended to conflict with or interfere with the purpose and duties of other medical activities. Indeed, if it is to be successful it must be worked out by our industrialists with the coöperation of city, state and federal authorities on health; private or semiprivate health institutions, including hospitals, sanatoria, dispensaries, health-promoting agencies, social agencies, etc.

The plan aims to avoid the conflict or competition with the local practitioners restricting the features of the clinics in all ambulatory cases to emergency surgical treatment only and diagnostic work; and reporting the physical findings of the sick employee to the private physician and coöperating with him in

means of treatment, etc.; in other words, give him the benefit of all expert knowledge and equipment which we possess for the threefold benefit of patient, employer and private physican.

Rather than reducing the sum total of medical attention and activities required, this system would result in a greater sum total of medical attention than heretofore.

It would banish the pernicious tendency now existent on the part of the employer of delegating to insurance carriers the furnishing of surgical service in compensable injuries and give to the employee the best medical talent procurable with an attached personal interest which cannot be overestimated in its psychology.

My aim, then, is to set up a system of health supervision for all industries in Philadelphia. To eradicate the evils mentioned and their vicious consequences, and to give to the mass of our workers a service which will be a full realization of their needs, and after studying the problem from every angle and finally having the endorsement of the Philadelphia Chamber of Commerce, leaders of industry and the Philadelphia Association of Industrial Medicine, I submit the plan for your consideration.

DECEMBER 16, 1921

Review of the Injuries to the Hands and Fingers in a Steel Plant during a Period of Six Years

BY LOYAL A. SHOUDY, M.D.

As a student I was always impressed with the teachings of the late Dr. Gwilym G. Davis in his applied anatomy. He always brought home to us the use and why of a part. And a very plain and sufficient use or why it was. He would say, "We have fingers to grasp, to feel, to hold, to protect." And in the industrial sense we have fingers to "work."

From the very nature of these parts, the hands and the fingers,

the constant use in work and exposure brings them in contact with and exposes them to injury.

To the worker the hand is a most valuable asset; cripple the hand and you cripple the earning power.

I am aware of the value of the balanced human machine, the part played by the eye, the leg, etc.; but the hand: well, you know how the hand feels in gladness, in sorrow—the hand of the friend! It is my pleasure to work with men who use these valuable parts and my pleasure to help them to realize how valuable the hand really is.

In looking over the records of the work in the Bethlehem Plant for the past six years my attention was called to the total number of new cases treated in the Plant Hospital—272,501, and of this number injuries to the hands and fingers comprised 37.5 per cent, or 102,188. This is a large number, and when you consider that the greatest percentage of industrial accidents affect these parts, it behooves us to direct our most strenuous efforts toward the best possible treatment in order to return the worker in the best possible condition and in the shortest time.

In this series of 272,501 cases of injury to the hands and to the fingers the degree of injury and the cause varied. Lacerations, contusions, burns, fractures and infections are the most often met.

The total number of lacerations of all parts of the body was 87,199 and 83 per cent of this number, or 72,374, were of the hands and fingers.

The total number of contusions of all parts of the body was 23,708, and 41 per cent of this number, or 9721, were of the hands and fingers.

The total number of burns of all parts of the body was 15,531, and 35 per cent of this number, or 5437, were of the hands and fingers.

The total number of infections of all kinds was 16,350, and of these 34 per cent, or 5437, were traceable directly to injury; 1845, were of the hands and fingers.

The total number of fractures in all parts of the body was 2045,

and of these 704 were of the hands and fingers; fingers, 468; metacarpals and carpals, 236.

As to the cause of the various accidents this varies, but bear in mind that we require all injuries to report to the clinic no matter how trivial they may seem to the man. It is difficult to get the men trained to this part of the work, but when they once see that they are the ones who benefit the case is won.

Handling of material, hurry, carelessness and "the other fellow" are the usual causes given. I feel that the number of cases treated and the results attained warrant me in presenting this report to you, and I thank you for the privilege of appearing before your Section this evening.

In our work laceration covers abrasions, scratches, clean-cut or sharp, incision-like, jagged or torn, crushed and punctured—we have not classified them in this series. These lacerations vary in extent and importance. By far the greatest percentage cause no loss of time and heal with the simplest care.

The ones which give concern are those involving tendons;, those liable to infection; those destroying blood or nerve supply followed by ankylosis, paralysis and atrophy; those which remove parts of the finger; those which reach the periosteum; those caused by excessive trauma and punctures of various kinds. Then, again, we had to consider lacerated wounds of fingers from brass, steel, tin, powder, the various high explosives, paper, wires, etc.

In considering lacerations the first examination must always be thorough, keeping in mind the return of function. To the inexperienced it is so easy to slip up on the severed tendon or the importance of the punctured tip. Most of the lacerations come to us in what you may call a "dirty condition." They are soiled but easily cleansed, and there seems to be some protective in the ordinary grease and smear of the machine shop.

In examining lacerations of the hands and fingers, especially of the flexor surface, be careful to detect severed or partially severed tendons. Caution against violent movements lest they complete the tear of the already partially torn tendon.

The location of the laceration does play a part in the recovery

and function. As a rule, lacerations on the flexor surfaces require greater care and more time for healing. Laceration into the folds of joints, where movement is constant, flexor or extensor, aggravate conditions. Lacerations parallel to the line of fingers and lacerations of inner aspect all present a problem as to treatment and result. You must ever bear in mind that a workingman does not want to lose time because of a little cut.

As I said before, the greatest percentage of these small cuts "get well" and are lost sight of; but severed tendons, amputated tips and cuts into joints do give us concern. The laceration resulting in severed tendon to hand, finger or fingers is not relished by the surgeon, because tendon suture at best is a difficult procedure.

I do not want to bother you with too much treatment, but I do want to say that we follow the simplest possible method and believe in the teaching, "Let them get well."

For small cuts, as a general cleanser, we use benzine, benzol or gasoline, followed by 3 per cent alcoholic iodin and sterile dressing. For wounds into folds we use a 60 per cent alcohol dressing.

Puncture Wounds. Enlarge if necessary and inject or swab with tincture of iodin and drain. Bad or extensive lacerations: cleanse shop dirt with gasoline (because it removes grease, etc.); soak in warm chinosol solution; cleanse with tincture of green soap. Remove mechanically all traumatized tissue. In all suture work use sutures sparingly; tie loosely; sometimes insert and tie later. For skin use silkworm-gut and mattress suture. Dress loosely with wet dressings and support with splints. Always caution the man to be careful. In cold weather cover sufficiently. When tendons are involved it is in the greatest percentage the flexors, and remember that tendon repair is at best a hard job; be extra careful in handling; go easy; do not open sheath any more than is necessary. As a rule, you do not have a choice of incision, but if you do, we believe, as Kaufman advises, that the incision on the side of the finger, where possible, gives the best result.

"The great difficulty in injuries of tendons is in the retraction of the cut ends—a separation which is greatest when the tendon lies in a long synovial canal." Ends become adherent in this position and muscles suffer atrophy from disuse. Whenever there is a possibility that tendons have been injured in a wound, especially in the anterior surface of the hand and forearm, the action of every muscle should be examined. Make all movements of the hand; spread the fingers (ulnar nerve) and flex while spread. Be careful that all examinations are made under aseptic precautions. In looking for a cut end you may have to make two incisions.

Remember that the dressings and after-treatment bear a relation to your end-result. As a rule, flexors give better results than extensors. Adhesions to the skin give trouble, adhere to the line of the skin scar and stiffness. Do not forget in dressing to dress so as to relieve all possible strain. Relax. Fifteen to eighteen days without movement. In all tendon work go slow, have patience, use care.

In tendon suture of the fingers use small Hagedorn needles, because they separate and do not tear the fibers. Silk is usually recommended, but we have secured the best results by using 0 to 00 chromic gut. It is a good plan to insert a tension suture to relieve the pull on the tendon suture. Primary suture is better than secondary suture, but in the presence of sepsis, primary suture is contraindicated.

In traumatic amputation do not attempt to do a "classical job" in each case. Nature, with granulations, heals many a stump. Be careful that nerve ends are not caught in the muscle suture or the skin line. Do not amputate at the joint; go above or below, remembering to save all that you possibly can, and at the same time give the best working finger. Be careful in the handling of tendons, as they are delicate and easily injured. Do not draw your sutures. Tie loosely and in some cases place the suture and tie later. Use rubber bands for drains. In all amputations from trauma be careful to remove all traumatized tissue. Your result will be good accordingly. Remember that

the skin retracts and has a tendency to pull tight over the stump; be sure that you have sufficient. In many cases the skin of the amputated (partially) portion can be utilized as covering. Dress loosely and keep warm and protected. Use a splint.

There is an excellent article on tendons by Skillern in the *Murphy Clinics*, April, 1916.

Bear in mind that to a man who earns his livelihood with his hands it means much, and he is entirely in your care. One stiff finger impairs the use of the others and the hand. The stiff thumb can be utilized by apposition, but a stiff finger is in the way.

In bad lacerations we take into consideration:

1. Cleanse.
2. Repair.
3. Dress.
4. Rest and heat.
5. Let them get well. Do not do too much.

Next in frequency we find contusions, and 41 per cent of these are located in the hands and fingers—9721 in this series.

In comparison 20 per cent of the contusions are of the foot and toe.

Contusions of the fingers are very painful to the injured and hard to relieve. Injuries to the soft parts, the nerves and the vessels, with escape of blood and serum and the resulting pressure, with danger of subsequent breaking down and infection and loss of function, cause no end of trouble to the one who tries hard to do something for their relief.

Tips of the fingers are the most often affected, and exposure is probably the best reason.

In all so-called contusions of the hands, fingers, feet and toes be careful not to overlook fractures; the x-ray should be used routinely. I am aware of the caution and teachings of our older men, "To train your fingers, your eyes and your head." Do this, but add the x-ray. Fingers are worth money, earn money, and, if you want another measure, cost money.

Tenosynovitis, with contraction of the tendons, may occur from contusion or when the contusion involves the tip of the finger and the nail.

To cleanse and drill the nail, release the blood-pressure and for the immediate pain apply heat by hot solutions.

Bear in mind that contusion of a finger may cause rupture of a tendon, with no break in the skin.

Contusions or bruises other than from falling material may come, as from handling a wheelbarrow, or, as in the case of the bricklayers, on the base of the thumb from the trowel, or from using the hand as a hammer—so-called stone bruise—from striking the ends of the finger on some hard object or punching a fellow-worker's face.

This gives you the so-styled baseball finger or thumb—a disturbance of the joints. One may also receive from bruises injury to the bones other than fracture, as periostitis or tuberculosis secondary. Tuberculosis, as a result of the contusion, the same as in the hip.

In contusions we must treat with pain, dislocation, swelling (hematoma) and interference with function.

In the treatment we follow the first law, make the part comfortable if slight, and after careful examination, and you are sure that no other injury exists, cleanse and apply a dressing of mercury and belladonna ointment or a 20 per cent ichthyol or lead-water and alcohol.

In the case of the hand with marked hematoma use pressure, rest, splint and heat or cold with elevation. Pressure well applied is a good general measure of hematomas.

If the contusion is severe, cleanse and apply a dressing of magnesium sulphate, a splint and a sling (elevation).

Do not forget that the natural position of the fingers and hand is semiflexed. Do so on the splint.

Later Treatment. Baking and light massage may be used. Soaking in hot water is a pet procedure of many of the workers. (Done at home.)

In hematomas (other than blood blisters) go slow on incision; it is dangerous to convert a closed wound into an open one, and your class of patients must be considered.

Burns in this series number 15,531; of the fingers and hands, 5437, or 35 per cent of the total injuries.

In our work, burns as an injury to the hands and fingers rank third. The cause varies, as from actual burn, splash of hot metal, electric flash, hot tar, acids, hot water, steam, powder, in contact with a hot plate, bolts, etc.

The injury from burns is generally in proportion to the extent and degree, but location must also be given consideration.

The process of healing is often prolonged and results in cicatrices, which become painful and exceedingly sensitive to pressure for a long time. Cold weather causes a cracking, especially where these cicatrices extend from the hand onto the fingers.

The ability to work may be greatly interfered with, especially if the man is unable to hold anything in the hand.

"Burn scars are unfavorably affected by cold weather; hand feels cold and looks blue," and the scars when they break open heal more slowly than at other seasons, due to the thin, atrophic, contracted scar tissue.

We have learned that burns from hot splash metal are most stubborn, most apt to give trouble with infection and cause greatest resulting disability, due no doubt to their usually being third degree and the metal sticking fast.

We cleanse all burns with gasoline; open blisters but do not remove the skin; then dress with unguentum Bi 6, wax 10, petrolatum 84, above the melting-point of the body. Completely cover the burn. In less extensive cases try to bandage so as to allow the patient to return to work. Dress daily and cleanse. Advocate the use of unguentum Bi, as it does not stick, gives the wound a chance to heal, does not destroy new tissue, is aseptic and relieves pain. Various methods and ointments, each to his choice, but we use this because we get results.

Where there is excessive discharge we cleanse with warm chinosol solution and use waxed gauze of wide mesh and wet chinosol dressing. Splint when the part needs rest.

After-care is massage, and keep from drying by the use of vaseline daily. Move as soon as possible to prevent contractures and stiffness.

Fractures. Hands and fingers, 704 out of a total of 2045 for this series (compound 263 and simple 441).

Fractures considered are of the carpals, metacarpals and phalanges. In our series fracture of the carpals was not frequent. Sprains and dislocations are also comparatively infrequent. The dislocation of the metacarpophalangeal joint in the thumb, so well described in all text-books on fractures, was not met. The carpals were comparatively free from fracture: 8 scaphoids, 1 os magnum, 1 unciform and 2 semilunar comprising the list.

Fractures of the metacarpals are more frequent and are generally caused by direct violence, as from heavy objects or being caught between jobs. The extent of injury and resulting disability depends on the location of the fracture, the direction of the line of fracture—transverse, oblique or longitudinal—and whether the fracture involves the shaft or the end of the bone.

The simple fracture of one metacarpal, when properly handled, does not result in any great deformity. Crushes, as by gears and cog-wheels, present problems which tax our ability and patience. In these cases we must bear in mind that we must endeavor to secure the best working hand with as much function as it is possible to obtain.

Fracture involving two or more metacarpals may cause trouble, and is a cause of difficulty in getting in good position; especially is this true if the fracture is near the joint; occasionally the head of the metacarpal bone is displaced forward, in which case the corresponding finger cannot be properly flexed and the man is unable for some time afterward to maintain his grasp on an article. The cause of this disability is the pressure exerted by the head of the displaced metacarpal bone. When after fracture of the head or base of the bone, with complete lateral dislocation, the bone becomes fixed in this position the deformity assumes a serious functional import.

Cases of fractures of the head of the metacarpals, where it involves the whole joint, including the articular portion of the proximal phalanx, are usually marked by ankylosis of the mid-phalangeal joint as well as the metacarpophalangeal joint itself.

causing the affected finger or fingers to become fixed in flexion, thus impairing the usefulness of the whole hand.

Bear in mind that fractures of the metacarpals cause atrophy of the muscles, as of the ball of the thumb and little finger from a fracture of the first metacarpal, and of the neighboring interossei from the fracture of the second or third; this causes a weakness of the hand.

Best results are obtained by treating "over-the-bandage" method, followed by massage.

Sprains of the hand proper were met in two cases.

Sprains of the joints of the fingers do occur, as from violent pulling either in an attempt to free a "stuck" job or to free the caught fingers; usually the capsules and lateral ligaments of the joints suffer, especially the metacarpophalangeal joints. The result is that the man complains of an inability to hold on with his usual strength. Dislocations of the fingers were met with in ten cases and are easily reduced if seen early. Subluxation unrecognized is sometimes followed by ankylosis, with resulting stiffness and impaired functions.

Of a total number of 2045 fractures, 704 were of the metacarpals and phalanges or fingers. Of this the fingers numbered 468 and the metacarpals 236, or about 2 to 1, *i. e.*, fracture of a finger occurs twice as frequently as a fracture of the metacarpal.

Fractures of the fingers are usually direct, generally from blows or falling objects, or missing the job and hitting the finger.

The so-styled "bad" fractures of the fingers occur in injuries involving a severe crush of the hand. The resulting condition from fractures of fingers as affecting the usefulness to the worker depends on the location and kind of fracture as well as the finger involved.

In these cases results to the fingers are usually a thickening at the point of fracture with stiffness, and if a joint is involved the finger becomes stiff and fixed in a position of flexion or extension.

In general the treatment of fractures is called simple, but that is not our experience.

As a general thing, remember that relaxation is advantageous;

follow the natural position of the hand; use the roller; cleanse the hand and dry; use extension in combination with the roller and the splint by means of adhesive; place gauze between the fingers.

In compound or open-finger fractures do not be too eager to suture; treat open until you feel sure of a clean wound. Splints molded to contour are valuable. Passive movements such as slight rubbing should be begun early. Be careful to maintain alignment as rotation on the long axis of the lower fragment is prone to happen. Well-applied plaster is excellent, especially for the thumb.

In conclusion of fractures, I desire to call your attention to a class of finger fractures which we call "chip" fractures.

About eighteen months ago my associate, Dr. Hurley, of the Fore River Plant, called attention to this form of fracture and suggested the proper care.

The chip fracture most frequently results from direct violence and involves the distal phalanx and varies in the extent of damage to the bone. In most cases a small chip is separated from the main tip and is overlooked, the injured finger being treated as a contusion. Later, if unrecognized, the worker returns with pain (constant pain), made worse when he attempts to pick up objects or pull. Sometimes there is a breaking down, and they are then diagnosed as felons.

The cause is simple and the diagnosis is difficult unless you x-ray, which should be done.

The treatment is to splint and put at rest. The blood supply to the fragment is small, and this probably is a cause of breaking down, plus added trauma to the other nearby parts. In persistent pain or signs of infection cut down and remove the fragment. I have seen one badly infected finger from neglected chip fracture, and Dr. Hurley reports a worker with a marked phlebitis of the leg following a chip fracture of the toe.

The insignificant origin of the majority of infected wounds and the great danger of permanent impairment or loss of functional power which they entail make a clear understanding of the subject of importance to us.

Infected wounds necessitate a longer course of treatment than non-infected wounds, and their prognosis is always less favorable. Sometimes the process of healing is very protracted.

In the great majority of cases the infectious process begins in a trifling wound of a finger, caused by a prick, a scratch or the entrance of a splinter. The lower extremity is seldom affected. The wound does not bleed and is often scarcely discernible. The anatomy of the skin furnishes the explanation of the serious consequences of such an injury; if the wound reaches the Malpighian layer of the epidermis the door is opened to the entrance of infection. The injury being so slight it does not occur to a workman to put down his work. If he feels uneasy and speaks to his employer about it he is likely to be told not to stop work for such a trifle. So the splinter, for example, is removed by the workman himself, who then ties a dirty rag around his finger and resumes work. Three days later fever, with pain and swelling of the part, usually begins; the pain rapidly increases and soon runs from the finger up the hand and arm to the axilla; the whole hand is red and swollen and hot and resistant to the touch. We have to deal, in short, with a phlegmonous inflammation, or, in popular language, with a case of "blood-poisoning." The infectious germs may have entered at the time of the injury or afterward through the wound. The incubation period is usually about three days; it may, however, be as short as twenty-four hours or as long as three weeks.

For the case not seen by the physician until it is well developed a bad prognosis in respect to functional power must almost always be made. Repeated operative procedures on the fingers and hands are generally called for, which, as a rule, result in permanent disability of the part. The fingers are usually left quite stiff, while the hand, fingers and forearm are lined with scars; the skin feels cold and is often cyanotic (glossy skin).

As already stated, infected wounds are almost always found on the hands. In cases of involvement of the thumb or the little finger the condition is especially serious, for the reason that the tendon sheaths of both communicate with the common tendon-sheath of the flexors of the fingers.

The advisability of obtaining medical advice as soon as possible is seldom so forcibly illustrated as in case of infected wounds. The earlier the treatment is begun the better are the chances for a favorable course and recovery of functional power.

Infections. The case of infections *versus* industry has been heard in many an industrial clinic and the verdict varies with the work, workers and the doctor judge.

I am happy to say that in our clinic court the verdict is favorable to the defendant worker and counsel.

In this series of 272,501 injuries infection was met in 16,350, or 6 per cent. This number includes infection from all causes, whether due to injury or not; classed in this number are styes, pimples, teeth, ears, T. N. T., antimony, fissures, urethritis, conjunctivitis—in fact, any form of infection other than original burns which applied for advice or treatment.

Of this number 35 per cent, or 5722, were traceable directly to industry, and of this 5722, 1845 involved the hands and fingers.

Of this 1845, 80 were of such a nature as to involve a lost-time period sufficient to appear on the compensation list.

Our total compensation list of this 272,501 injuries numbered 4026; of this 4026 compensation cases, 80, or less than 1.98 per cent, were due to infections of the hands and fingers. In a series of 400 hand and finger suture cases, including amputations, tendons, compound fractures or sutures of any nature, 5 became infected. The total number of infected wounds, etc., of the hands and fingers was 1845:

In this number 80, of severe infections, 1 resulted in a bad hand deformity, and was the only infection involving the deep palm.

Two cases were fatal, due to tetanus—1 a neglected injury from the open-hearth department (three days), the other following a crushed hand after hospital treatment sixteen days after original injury; 20 resulted in loss of a portion (bone) of the finger infected; 65 involved a single finger.

I cannot give you the actual number of deformities because some of the patients have since left the plant.

The cause of infected fingers and hands you all know. Neglect is perhaps the greatest factor.

Granted that the greatest cause is neglect and carelessness, our aim then should be to remove the cause to effect the cure. The average worker does not like to stop long enough to have scratches taken to the "Doc"—but he can be shown. With us it has been and is a process of continuous education.

Prevention. Treatment comes next, and for our results in keeping down infection of all kinds credit must go to the men who have developed the habit of coming early and to the work done by the clinic, capable, intelligent, interested nurses, coöperation of all kinds to the good of the injured worker. In treatment we have endeavored to follow Kanavel, and to improve on his wonderful work is a task too hard for me. If you follow his teachings I am sure your results will be all that could be desired.

One thing, though: I do not agree with him when he says to give the foreman a bottle of iodin and allow him to daub all who apply. To us this is bad practice; it causes the men to feel that iodin is a cure-all, and they feel they need not report; and again, iodin burns or blisters make a good field for the growth of various pus producers. Iodin concentrates on standing, an added danger. Teach the men not to pick out splinters, but to go at once to the dispensary. We teach first-aid but do not allow the men to treat.

We believe in early treatment, and when necessary early hospital bed treatment. "The proper diagnosis of the type and nature of the infection, and the exact location of the pus, proper incision, drainage and care not to spread the infection to other spaces," are important points to remember.

Lacerations, contusions, burns, infections, fractures, sprains and dislocations contribute the greatest number of hand-and-finger injuries in the steel plant. Among other conditions which we have not classified, because some are more or less a rarity and the exciting cause a question, are the results of injuries elsewhere, as: Dupuytren's contraction, 2; tuberculous arthritis of the carpals, 2; tuberculous tendons, 2; tuberculous dactylitis, 2; clubbing of the fingers, 2; tuberculous dermatitis, neuroses, cysts, ganglions, etc.; frost-bite, freezing.

Infection, laceration, contusion, burns of the arms affecting the hands and fingers, cut vessels, nerves, tendons, scars, etc., have not been considered under hand and finger injuries. We are aware that many other conditions are possible as a result of injury, but fortunately they did not occur with us. After preparing this paper to present to you I am more than aware that any one condition is of sufficient size and importance to have separate consideration.

Tenosynovitis from an industrial viewpoint, especially in the heavier and faster work, is field enough for investigation.

In this series the loss of the use of the hand from injury occurred in 11 cases (5 right and 6 left), 10 due to crushes and fractures and 1 due to infection.

Amputation of the hand occurred in 10 cases (6 right and 4 left); of the 4026 injuries resulting in compensation, 1304 were due to injuries of the hands and the fingers.

From this series we have learned the importance of the early reporting to the medical department clinic of all injuries, and especially of the hands and fingers.

We have learned the value of a careful examination of all injuries by the doctor.

We have learned the value of the x-ray in contusions.

We have learned the value of cheerful efficient treatment, well administered by people interested in the worker himself as well as the injury to the body part.

We have learned that the general physical and mental attitude of the wounded worker bears an influence on the ultimate outcome.

We have learned that team-work gets results. Get the injured man to work with you.

We have learned that in industry the doctor and assistants must be a part of the plant and work with the plant if they expect to succeed.

We have learned that the simple treatment is best.

We have learned that our success was in proportion to our efforts.

PROCEEDINGS

OF THE

SECTION ON MEDICAL HISTORY

The French School of Surgery in the Reign of Louis Philippe.[1]

BY J. CHALMERS DA COSTA, M.D.

The great French school of surgery which flourished in Paris from the close of the Napoleonic wars until into the reign of Napoleon III had an immense influence upon the surgery of the world, in America as well as Europe. It reached its acme in the reign of Louis Philippe.

Among the many surgeons who were particularly enthusiastic in bringing some of the teachings of the French School to America were J. Mason Warren, of Boston, Prof. Gibson and Thomas D. Mütter, of Philadelphia. Almost the first literary effort of the elder Gross was a translation of Tavernier's *Operative Surgery.*

During the reign of Louis Philippe students gathered in Paris from all parts of the world. There were over thirty hospitals and about five thousand students of medicine. One who would specialize in toxicology, obstetrics, microscopy, orthopedic surgery, genito-urinary surgery, dermatology, venereal diseases, ophthalmology, pathological anatomy, medical diagnosis, plastic surgery, experimental physiology, higher chemistry, nervous diseases and insanity, or comparative anatomy had to go to Paris. Paris set the fashions in social customs, in literature, the drama, music and in science. France was the laboratory of the world,

[1] Read November 30, 1921.

in which experiments of the most daring sort were being made in art, government, science and literature, and Paris was the incandescent crucible in this laboratory.

The city contained the very best organized hospitals in the world. The twenty thousand hospital patients were used for the instruction of students and the various dispensaries were thronged. Medical science had attained a high stage of dignity. Subjects for dissection were plentiful. This was a time when dissection was viewed with horror in England. The intern was still a student of medicine. The term was four years and he received a salary of four hundred francs a year with board and lodging, and he was allowed to take private classes through the wards and quiz students in the evening. An intern was obliged to have been an extern for one year first, and an extern attended the hospital twice a day to be of what service he could. The Hôtel Dieu alone had one thousand beds. Orfila, the first man to devise the method for detecting poison in the tissues, was professor of toxicology. Breschet, the distinguished surgeon, succeeded Béclard as professor of anatomy. A common picture in the works of anatomy today, showing the veins of the diploë, is from Breschet's preparation. Sappey and Gosselin were the demonstrators of anatomy. A fracture of the radius is named for Gosselin, and Sappey became specially distinguished because of his studies of the lymphatics.

The great Cruveilhier was professor of pathological anatomy; Andral, of general pathology; Trousseau, of therapeutics and materia medica; Dumas, of organic chemistry; Margolin (we use the term "Margolin's ulcer" today) of surgical pathology; Pelletan, of medical physics; Broussais, of the practice of medicine; Moreau and Dubois, of obstetrics; Gay-Lussac, of chemistry; Louis, Chomel and Rostan, of clinical medicine. The professors of clinical surgery were Roux, Clouquet, Velpeau and Berard. Magendie and Bernard were teaching in the College of France.

Until his death, in 1835, Dupuytren was one of the very eminent professors of surgery. The great name of Lisfranc does not appear in the list of the faculty of medicine.

We will say a few words particularly of these men: Dupuytren, Baron Larrey, Lisfranc, Velpeau and Roux.

Dupuytren was a kind of emperor of surgery. He was an immensely brilliant operator, exhibiting marvellous dexterity, proceeding with almost inconceivable speed. He was thought to be an extraordinary diagnostician.

Whereas Dupuytren profoundly modified surgery in all its branches, devoting particular attention to surgery of the bones and joints, hernia, tumors and other branches, he left one dominating opinion, namely, that inflammations of the right iliac fossa arise from the cecum. Mellier maintained that inflammation in the right iliac fossa was due to the appendix and not to the cecum. Dupuytren annihilated this view, and Dupuytren's opinion remained supreme for over fifty years. Mellier, who was right, disappeared and the wrong view remained with the most ghastly results.

Larrey had been the great surgeon-general of the great Napoleon, and he of all men was most responsible for the modern system of care for the wounded on the battlefield and beyond it. He invented the flying ambulance. He invented the principle of field hospitals. Whenever the army paused for a few days the surgeon would assemble schools for instruction. He trephined for meningeal hemorrhage. He opened the chest and drained for gunshot wounds of the lung. He was preceded only by Walter Brasshear in amputating at the hip-joint. He used chlorinated dressings for infected wounds. He operated for empyema in direct opposition to the general practice of the times. He was a strong advocate of resections. The best-known amputation at the shoulder-joint still goes by his name. His military memoirs is one of the most delightful and instructive of books. Unfortunately, he opposed the plan, previously advocated by Desault, of excising gunshot wounds.

A great rival of Dupuytren was Lisfranc. In their lectures they exhibited fierce animosity toward each other. Lisfranc referred to him as "the bandit of the river bank," and he refers to Lisfranc as "that man with the face of an ape and the heart

of a crouching dog." In these rows the students participated. Lisfranc was considered one of the very greatest operating surgeons in France. This distinction he shared with Dupuytren and Roux. His name is still in the pages of operative surgery.

Velpeau had come from great poverty to the utmost distinction. We can see him in his old age if we read Daudet's *Kings in Exile*, for old Burchereau was drawn from Velpeau. He was the son of a blacksmith; taught himself to read and write; studied medicine at Tours; became an assistant of Bretonneau, and finally went to Paris, where he became eminent in both surgery and obstetrics. His book on *Operative Surgery* profoundly influenced American practice, and his book on *Obstetrics* was put into English by Prof. Charles D. Meigs. He had the curious tendency to throw a man for graduation if the applicant affected whiskers.

Among the great surgeons of this school we must mention the following:

Nélaton, the inventor of the flexible catheter and the porcelain-tipped bullet-probe. He has been put into fiction by Ohnet in his novel, *Doctor Rameau*.

Amussat, who introduced torsion for the arrest of hemorrhage; who gave lectures on experimental surgery; who published a discourse upon the entrance of air into the bloodvessels; who invented the double saw used to open the spinal canal in post-mortem examinations; who stood practically alone in advocating suprapubic lithotomy and whose study of the anatomy of the urethra led him to devise an operation for crushing stone in the bladder, apparently before Civiale's observations.

Marjolin, the great pathologist and diagnostician.

Civiale, who perfected and made practical the operation of crushing stone in the bladder. In order to increase his dexterity he used to walk through the streets of Paris with a lithotrite in his right hand trying to pick up nuts in his coattail pocket. The operation of crushing came to be named Civiale's operation until it was greatly improved by Bigelow, of Boston. Lisfranc submitted himself for operation to Civiale. Civiale performed lithotripsy over one thousand times.

Clouquet, Lafayette's personal friend, whose views on hernia we still quote, and who several times performed major operations upon hypnotized patients.

Guérin, one of the very first men to devote himself to the study of deformities, hence one of the founders of orthopedic surgery, and who probably devised the operation of subcutaneous tenotomy.

Joubert, the first to utilize the principle of the Lembert suture on human beings.

Malgaigne, whose great work on fractures and dislocations is still referred to.

Ricord, who was born in Baltimore of French parents; studied for a year in the University of Pennsylvania; went to Paris as the bearer of some specimens to Cuvier; finished his course in that University; became the greatest authority of his age on venereal diseases, proving the duality of syphilis and chancroid. Ricord was a master teacher. We still remember his designation of the glands below Poupart's ligament as the moral glands and the glands above Poupart's ligament as the immoral glands, and his calling the glands of the groin the *glandulae Pléiades*, and his illustration as to the looseness of the hair of a syphilitic, when he said that if a syphilitic fell overboard, and someone attempted to save him by grasping his hair, he would be drowned. He is referred to in Daudet's autobiographical work, the book in which the great French author described his early days in Paris.

Of Roux, who made the operation for cleft palate a successful procedure; who was noted for his cataract operations. Gross used to say of him, as he said of Levis, that his operating was the poetry of surgery.

Many others we would mention: the younger Larrey; Richerand; Blandin (after whom a gland is named); Boyer; Maisonneuve (after whom the urethrotome is named); Chassaignac (after whom the carotid tubercle of the sixth cervical vertebra is named); Hugier (after whom a bony canal is christened); Sanson; Cullerrier; Denonvilliers and many others; and I have not mentioned many of the most eminent alienists, ophthalmol-

ogists, obstetricians, etc. Certain it is that never in the records of medical history have so many surgeons been gathered together in one city at one time as constituted the teaching force of Paris in the reign of Louis Philippe.

London Surgery in the Early Part of the Nineteenth Century[1]

BY JOHN H. GIBBON, M.D.

The early part of the nineteenth century saw in the operating theatres of the great London hospitals men whose teaching and writings greatly influenced American surgery and with whose names every student of medicine today is familiar. At this period Astley Cooper was teaching at St. Thomas's and Guy's; John Abernethy, at St. Bartholomew's; Benjamin Brodie, at St. George's and Charles Bell, at the Middlesex. These names are writ indelibly on the pages of surgical progress. Another name, not so familiar but probably as much on the tongue of his contemporaries both lay and medical, was that of Thomas Wakley, the founder of the London *Lancet,* who has passed down to us as a great medical reformer, but who was looked upon during his early career, and not without some reason, as a meddler, a busybody and, to use a more modern term, a "mud-slinger."

On the present occasion we will say briefly something of the life and work of two of the great surgeons of this period, Cooper and Abernethy, and then at greater length consider the activities of Wakley, directed at the reformation of the great London hospitals, and of the teaching of surgery, particularly as they affected Sir Astley Cooper and John Abernethy.

Sir Astley Cooper stands out preëminently among his contemporaries as the master figure in the world of surgical work

[1] Read November 30, 1921.

and teaching. By them he was designated the "Prince of Surgery," and the "Wellington of British Surgery." His physical appearance, as well as his gentlemanly bearing and his mental attainments, did much to place him where he stood. His accomplishments as an operator, a teacher and a writer of surgery were not spoiled by defects of character or behavior, so that one going to his clinics, after hearing of him and reading his writings, never felt that his idol was one with "feet of clay." His was not a personality of which one could say "distance lends enchantment" or "familiarity breeds contempt." All his students and those who visited his clinics from foreign lands admired and respected him the more because of their more or less intimate contact.

One can get some conception of the man from the following description of him in later life by William Gibson, professor of surgery, University of Pennsylvania (*Rambles in Europe in* 1839): "Imagine a tall, elegantly formed man, moderately robust, with a remarkably pleasing and striking countenance, red and fresh as a rose, apparently about fifty-eight or sixty years of age but in reality above seventy, very agile and graceful in all his movements, simply but handsomely attired, with the spirit and vivacity and bearing of a youth, with, in short, no marks of advanced age except a head as white as the driven snow—and a very just conception may be formed of the appearance of Sir Astley Cooper."

Cooper was born in 1768 and his youthful pranks and love of things other than the pursuit of knowledge gave no promise of what he was later to become. Perhaps it is enough to say that he was a son of a clergyman. His indulgences it should be said, however, were of an innocent and normal character and honesty and truthfulness his striking qualities. His father perhaps understood him better than any one else, for of him he said: "He is a sad rogue, but in spite of his roguery I have no doubt he will yet be a shining character." How much this comforting prognostication was due to perception of character and how much to parental prejudice, it is hard to say.

His intellectual awakening occurred when he was apprenticed

to the anatomist Cline, who inspired him with his first professional enthusiasm. From this time he became a hard student and one who loved his work. He married at the early age of twenty-three, which may have had the effect of impressing upon him the responsibilities of life. In 1792, a year after his marriage, he went to France, then in the upheaval of revolution. His safety and freedom to pursue his studies at the feet of such men as Desault, Dupuytren and Lisfranc in Paris was probably due to introductions by his master, Cline, who was supposed to sympathize with the revolutionary movement.

Among Cooper's great teachers, besides John Hunter and others of his own countrymen, should be mentioned the great Frenchman, Desault; the great Italian anatomist, Scarpa; and the great plastic surgeon of Germany, Dieffenbach. Desault must have excited great admiration in young Cooper, as he was not only a great surgeon but a great anatomist. It was he who revived for the second time the ligation of arteries in amputations, a thing unhappily forgotten after its first revival by Ambroise Paré in the sixteenth century. Desault's character is summarized by his pupil and biographer, Bichât, himself a great anatomist, in rather a peculiar manner: "Apprendre fut son premier besoin, savoir sa première jouissance, devancer les autres sa première passion." The last characterization is hardly one that appeals to our present-day ideas, or at least it is not one we would like to have attributed to us by our friends and admirers. I cannot believe that this desire to get ahead of others, for instance, was an attribute of Cooper.

In 1793 Cooper, at the early age of twenty-five, was professor of anatomy in Surgeon's Hall, and from this time on throughout his life he was the hardest kind of a worker, the keenest thinker and the most prolific writer. Early in his career he might have been described as an experienced surgeon, for experience in this sense does not mean time spent in surgical practice, but it means the perception of things as they present themselves to one, the ability to weigh and record them and to recall them to mind later; and at these Sir Astley Cooper was unexcelled. Much

of his later success as a teacher and writer may be ascribed to this highly developed power of observation and memory.

His notable contributions to surgical literature were in the shape of monographs, all of which showed originality and were based on large experience and thorough study. Among these one should mention his work on "The Membrana Typani," "The Thyroid Gland," "Hernia," "Dislocations and Fractures," "The Breast," and later, "The Testis." His lectures on "The Principles and Practice of Surgery" were also published in book form. For clearness of thought and comprehensibility his writings are unsurpassed. His lectures must have been of the same quality, for he was the most popular lecturer of his time.

A few years ago I saw a publication of the notes made by a New England surgeon of Cooper's clinical lecture on harelip and was struck by the fact that the operation he did then (1819) was practically that done today and far better than that in vogue twenty or thirty years ago. He laid stress on the importance of correcting the deformity of the nostril as well as that of the lip, condemned the use of pins and advised the use of no dressings. But for seeing these notes, made a hundred years ago, I would have supposed that our present-day operation for harelip was really modern.

One operation which seems a remarkable thing for a surgeon of his time to have done was the ligation of the abdominal aorta for iliac aneurysm. The patient succumbed, but the performance added to Cooper's fame, as it was the first performance of the operation. The ligation of the abdominal aorta has since been done twenty times, but always with the same fatal results excepting in a case recently reported before the American Surgical Association by George Tully Vaughan, of Washington.[1] Hamann, of Cleveland, reported in 1918 a case that survived an operation for six months and then died from a hemorrhage from a bedsore.[2] To get a proper conception of Cooper's operation it must be pictured as done in the preanesthetic and preantiseptic period.

[1] Ann. Surg., September, 1921.

[2] Trans. Am. Surg. Assn., 1918, p. 495.

Cooper was particularly fond of preserving pathological specimens and he had in his own house probably the largest and most valuable private collection in the world. Cooper died at the age of seventy-three and was active up to a short time prior to his death.

In 1768, four years before the birth of Cooper, John Abernethy was born. Unlike Cooper, "at an early age he manifested abilities, both general and peculiar, which were indicative of no ordinary mind, and which, though they do not necessarily prefigure the future eminence at which he arrived, were sufficiently suggestive of the probability that, whatever his career might be, he would occupy a distinguished position."[3] He, like Cooper, had the great advantage of attending the lectures of John Hunter and from him derived great inspiration. He too visited the Paris hospitals and came into contact with the great French surgeons already mentioned. Abernethy, again like Cooper, had a marvellous memory. It is said, on the occasion of his wife's birthday, a friend attending the dinner given in her honor presented to her some original verses. When he had finished reading them, Abernethy laughed and said, "You did not write those verses." But the embarrassed friend maintained his authorship and was much chagrined when Abernethy got on his feet and repeated every line word for word. The atmosphere was cleared and amiability restored, however, when it was discovered that Abernethy had memorized the lines as his friend read them.

Abernethy, in addition to being an anatomist and surgeon, was a philosopher, and his contributions were probably of a more strictly scientific character than those of Sir Astley Cooper. In 1787, at the age of twenty-three, on the retirement of Mr. Pott, he was made assistant surgeon of St. Bartholomew's Hospital and revived teaching at this institution, which had woefully deteriorated after Pott ceased his lectures. He gradually became, through his devotion to his work and his clear, philosophical

[3] Macilwain, George: Memoirs of John Abernethy, F.R.S., 1853.

way of considering the subjects under discussion, one of London's great teachers and was probably surpassed only by Sir Astley Cooper. Although the times in which they lived were not characterized by the politeness of our day and professional jealousies were less concealed and medical discussion franker and more acrimonious, these two great teachers seem to have been able to live quite peaceably together in the same small town of London.

Abernethy did much to arrest the reckless trephining for head injuries and drew a striking picture of the difference between concussion and compression of the brain. His study of this subject was probably much deeper than that of Desault, who condemned the operation much more forcibly and failed to practice it in the cases in which Abernethy clearly saw its advantages. The operation had become in the hands of some operators a "mischievous conventionalism," like so many others, even in our own enlightened day. The development of a dexterous facility in the performance of an operation, without the surgical judgment to recognize its indications and its contraindications, renders a surgeons a menace to society. Abernethy, like the surgeon he was, provided the judgment which showed the cases which should be trephined and those that should not.

Abernethy was distinctly an investigator. He was constantly carrying out scientific experiments of a chemical and physiological character. He was fond of comparative anatomy, and the study of the structures and of the physiological processes in the lower animals constituted one of his favorite pastimes. While Cooper was the great practical surgeon of his time, Abernethy was the great scientific surgeon. As assistant surgeon at St. Bartholomew's, a position which he held for twenty-eight years before being made surgeon, he had little opportunity for operative work in the wards, but during this period his scientific investigations, his constant contributions to the surgical literature and his teaching won for him a wide reputation at home and abroad and brought him a lucrative private practice. When he was finally elected surgeon to St. Bartholomew's, in 1815, he expressed his intention

of resigning at the age of sixty, and urged upon the board of governors to pass a rule making retirement at this age with a pension compulsory. Although the suggestion was not adopted Abernethy himself resigned as surgeon when he reached the age of sixty, but served one year additional at the earnest solicitation of the governors. He had suffered from that vicious system, which existed in many London hospitals up to fairly recent times, of keeping capable and distinguished men in the position of assistants when their seniors had long since passed the age of productiveness or even physical ability to perform their duties.

In his later life Abernethy bought a place in the country and tried, although too late, to preserve his health and physical strength by exercise on horseback. This pleasurable pursuit he was only able to follow for a short time and at irregular intervals, as he had a weak heart and before his death developed an incurable lameness. He died in 1831 at the age of sixty-seven.

No consideration of the surgeons, the surgery and the hospitals of London at the period of the two great men we have been discussing, would be complete without some reference to Thomas Wakley, the founder of *The Lancet*, who undertook with the establishment of this journal the correction of certain evils which he believed to exist in the hospitals and in the teaching of surgery.

Wakley's early career as an editor was a stormy one; it consisted largely in writing in a vitriolic and often scurrilous manner of surgeons and hospitals and in being sued for slander by those attacked in his journal. It is hard for us now to conceive of the respectable *Lancet* having been in any sense comparable to our sensational yellow journals, but it was in this complexion that it appeared to the vision of most of those who occupied high places in London a hundred years ago. One of the principal objects of its founder was the spread of surgical knowledge, as it was presented in the hospital lectures of the great surgeons, not only to the profession at large but also to the laity. The articles in *The Lancet* were not only read by the laity but were extensively copied by the newspapers, thus bringing the lecturers into

unpleasant notoriety. Its pages were not confined to medical matters, but dealt with political and theatrical news, so one can easily imagine the stir its appearance made in this conventional and conservative medical center. The editor believed that medical education and hospital positions were controlled by a few men to the exclusion of better ones and that nepotism was a potent factor in the selection of those who were to carry on the medical teaching. He was certainly fearless in his attacks, and the higher the man whom he believed deserving of criticism the more pleasure he took in the attack.

Wakley's career was too full to be even epitomized here, but a few of his encounters with the surgeons of his time will no doubt be of interest. He first published, without authorization, the lectures of Sir Astley Cooper. These were given verbatim, having been taken in shorthand, and were promptly copied by the newspapers. Wakley had been a pupil of Cooper, and the latter, not liking the publicity given his talks to students, remonstrated, with the result that a compromise was reached: The lectures were to be published in *The Lancet*, but Cooper's name was to be eliminated; a sorry compromise, as everybody knew whose lectures they were.

The lectures of Abernethy were then published with his name and in spite of remonstrance on his part were continued. Abernethy brought action against the publishers to prevent the publication of his lectures. He maintained that they were private property, while Wakley contended they were public property. While this action was going on in court, Wakley wrote very derogatory and unjust articles on Abernethy as a lecturer, saying among other things that all that was good in the lectures could be found in the works of John Hunter. After a number of months Abernethy was finally successful and the injunction asked for was granted by the court. Within less than a year Wakley applied for a withdrawal of the injunction, and, as it was unopposed by Abernethy, his petition was granted.

Two years after its inauguration, *The Lancet* dropped its dramatic, political and chess news and became a strictly medical

paper, but its contents continued to be reproduced in the lay press. One of the departments of *The Lancet* was that known as "Hospital Reports," and now continued as "A Mirror of Hospital Practice." Here were described cases presented or operated upon in the clinics and often the findings at autopsy. Wardrop was the man in charge of this department, and, of course, being an excellent surgeon himself, he was a competent judge of the matter which would appear. Most of the material came from Guy's and St. Thomas's hospitals and the reports at first were quite complimentary; but with the beginning of the second volume, criticism began to appear and later became so caustic that Wakley, an old student of St. Thomas's, was denied the privilege of its clinics and wards. This, instead of stopping criticism, only fanned it into fiercer flame and the reports of mistakes in diagnosis and treatment became more frequent.

Mr. Tyrrell, a nephew of Sir Astley Cooper and a surgeon to St. Thomas's, published a volume of the latter's lectures with illustrative cases from his own service. This excited the ire of the hot-headed editor, who wrote a scathing article, claiming that the lectures had been taken word for word from the columns of *The Lancet*. Later, his first article having brought no reply, he again attacked Mr. Tyrrell, accusing him of literary and professional incompetency and dishonesty. He asserted that Tyrrell's illustrative cases were badly chosen and that one was recorded as a success when the patient had died. This article was so scandalous that Tyrrell was forced to sue Wakley and the trial is interesting reading.[4] A verdict was given for the plaintiff and the damages assessed at £50. Following the verdict the irrepressible Wakley published in *The Lancet* a sarcastic review of the trial and repeated everything he had previously said of Mr. Tyrrell. He rallied Tyrrell's lawyer upon his statement that the publication of medical lectures was especially profitable. "How did he know that there was such profit?" asked Wakley. "If he (the learned Serjeant) would commence the publication of the next course of

[4] Sprigge, Squire S.: The Life and Times of Thomas Wakley, 1897.

gratuitous lectures delivered by his renowned client, Mr. Frederick Tyrrell, we will venture to assert that by doing so for the next seven years he will not obtain sufficient profit to purchase powder for his wig."

We will pass over Wakley's attack on the government of the Royal College of Surgeons and consider another suit brought against him by another nephew of Sir Astley Cooper. Under the caption, "The Operation of Lithotomy, by Mr. Bransby Cooper, Which Lasted Nearly An Hour," he published a dramatic description of an operation by Bransby Cooper and divided it into Acts I and II, with an epilogue, "The Autopsy." This was decidedly the most scandalous attack ever made by Wakley, and in reading it one cannot excuse the author whatever high motives he may have claimed. He practically described the younger Cooper as a bungling, incompetent ass, who owed his position entirely to the influence of his distinguished uncle. The greatest emphasis was laid upon the long time it took the operator to do an operation which a skilful one would have performed in six minutes. He was said to have lost his head and complained in the hearing of the patient that he did not know why he should be meeting with so much difficulty, and it was further stated that he made a false passage which was confirmed at autopsy. Dr. Hodgkin, the then lecturer on morbid anatomy at Guy's, testified, at the subsequent inevitable suit brought by Cooper against Wakley, that the false passage was evident only after the specimen had been handled in his absence by Mr. Lambert, the reporter of *The Lancet*, and it was his firm conviction that the rent had been made after death by Lambert. The trial excited the greatest popular interest, and, although Cooper won the case and £100 damages, one cannot but feel that Wakley enjoyed the publicity and excitement and had no sympathy for the man whose professional standing he did so much to ruin. Wakley had at this time a strong following, and after the trial he was given a great dinner at which the guests took up a subscription which paid the damages assessed against him and also the costs. Bransby Cooper weathered this storm and became one of London's distinguished surgeons.

Wakley, even in his own day, was considered to have accomplished a great deal to improve the profession, the teaching of medicine and the management of hospitals; but his methods were certainly drastic and were carried out regardless of the feelings and rights of others. How would we welcome a Wakley today?

The Dublin Medical School and its Influence upon Medicine in America[1]

BY DAVID RIESMAN, M.D.

The Irish, a mixture of primitive pre-Celtic peoples and of Goidelic Celts coming from the European continent, developed in the early Middle Ages, out of their own resources and untouched in any marked degree by the all-pervading influence of Rome, a remarkable indigenous culture. In particular they elaborated a native type of Christianity which with characteristic energy and wandering spirit they carried to Scotland, to northern England (to Northumbria), to France, to Belgium, and to Switzerland. St. Columba, of Iona, and St. Columbanus, of Luxeuil, stand forth as the great militant missionaries of that first flowering period of Irish civilization. Although they and their successors had to succomb to the greater might of Latin Christianity,[2] they left dotted over Europe a number of large monasteries which became active centers of learning for the medieval world.

Unfortunately for civilization, the age of learning in Ireland was of short duration. I have not the time nor is this the place to discuss the causes for the decadence of Irish culture. Those who are interested will find a keen analysis of the factors involved in Henry Osborn Taylor's *The Medieval Mind* and in Oman's

[1] Read November 30, 1922.

[2] The chief contentions had to do with the method of determining the annual Easter festival and the mode of tonsure and a few other trivial differences. All were smoothed out eventually at the Synod of Whitby in 664.

History of England, vols. I and II. Suffice it to say that for nearly eleven hundred years Ireland's influence upon European culture was negligible. Barring an occasional poet or essayist, or a universal genius like Robert Boyle, Ireland did not produce a perpetuating body of learned men who made their influence felt beyond the confines of the Green Island.

Of the history of Irish medicine in the Middle Ages little is known and the subject is largely an untilled field. Norman Moore[3] has resuscitated a few of the orginal manuscripts in the Irish language. The majority are translations from the works of Bernard de Gordon, especially from his *Lilium Medicinæ;* of John of Gaddesden's *Rosa Anglica;* of the works of Avicenna, of Averroës, of Isaac, and of the Salernitan School. Much space in these Irish manuscripts is given to the writings of Isidorus. This Isidorus is the famous Spanish churchman, bishop of Seville, who not only was a master of theology but wrote upon every branch of knowledge of his day. The fourth chapter of the twenty making up his *Etymologiæ,* perhaps the earliest encyclopedia extant, deals with the subject of medicine.

In one of the manuscripts (Arundel, 333), the date of which is 1514, a number of ancient and medieval authors are cited, among them one Philaretus, of whom little is otherwise known. His treatise is on the pulse and is based upon the teachings of Galen on the same subject. Philaretus, however, describes only ten varieties of pulse, while Galen classifies twenty-seven different kinds as regards size and twenty-seven as regards rate. What a memory task for the student of medicine of early days!

It appears that in ancient Ireland physicians commanded a high respect; thus Diáncécht, who cured the wound of Naudhat after that chieftain had lost his hand in battle and provided him with a silver hand and thereby with a kingdom,[4] is said in the ancient law-books to have given "judgments which were the first."

[3] St. Bartholomew's Hosp. Rep., 1875, ii, 145.

[4] There was an ancient law in Ireland that a man who was not perfect could not be king.

It is evident from the most cursory review of Irish history that the great Italian Rinascimento, which fired the dormant mind of France and Germany and paved the way for the Elizabethan period in England, somehow failed to cross the Irish Sea. But Ireland's Renaissance came eventually, and though it was late it was noble. It began with medicine and spread to literature and physical science, indeed to all departments of learning. The revival, as far as it concerned medicine, was in every way remarkable and gave the Dublin medical school in the first half of the nineteenth century a place of the highest importance and made of it a center whence the continent of Europe and the schools of this country drew inspiration.

We shall better understand the position of the Irish school if we review briefly the history of the medical schools of Europe. The first to emerge from the undifferentiated scholasticism of the Middle Ages was that of Salerno, whose influence, though shortlived, was enormous while it lasted. Montpellier took its place and is remembered among other things as the school where the great Sydenham studied. Next came the University of Paris and that of Padua. The latter though not disputing even remotely the palm with Paris, nevertheless was the alma mater of many great men. Paris from the time of Albertus Magnus, of Petrus Hispanus, and of Roger Bacon, the great Franciscan friar, never lost its high place except during the delirious period of the French Revolution. The University of Leyden came next as a Mecca and then Vienna, which brings us down to near the latter half of the eighteenth century.

About this time the Edinburgh school emerged upon the horizon and became a steady beacon light, shining with especial warmth upon the American colonies and soon after upon the young independent nation. It is no part of my task to discuss at any length the influence of the Edinburgh school upon American medicine, and I am referring to it merely because it is closely connected in aim and spirit with the Dublin school; and also because, in the formative period of our national life, a greater influence was exerted upon medicine by Edinburgh than by any

other place. In a very real sense, medical education in this country is a heritage from that of the Athens of the North. The period of Edinburgh's greatness coincides with the life of Cullen, the Monros, Drummond, Gregory, and the strange, enigmatic John Brown. As an index of the popularity of the Edinburgh medical school, we have the fact that between 1768 and 1788 sixty-three Americans studied there. Curiously, only one of these came from New England.[5] A minor reason for the strong trend toward Edinburgh was that one could obtain there the degree of M.D., while London bestowed only that of M.B.[6] The preëminence of the Edinburgh school endured about seventy-five years; then it waned, partly from a cyclical decline in the greatness of its men, partly because of keen competition, mainly from two quarters, Paris and Dublin.

Dublin's fame as a medical center was created by a few men and had no continuity. With their death died its renown; yet although its life was short—a span of scarcely twenty years—it had an influence that endures in this country to the present day.

Three striking features characterize the early development of medicine in this country. The first is an instinct for travel, as indicated by the large number of doctors in the young country, compared with the total number of physicians, who went abroad to study. It would not be altogether to the advantage of American medicine if the habit of going abroad were to die out, as some ultra-patriotic citizens fondly hope; but even if the practice should become rare, there is no reason why men should not go from one medical school to another in this country during their undergraduate years.

The second feature is the previously cited influence of the Edinburgh school. The Medical School of the University of Pennsylvania, the oldest in the United States, is the direct descendant of Edinburgh University, having been founded by John

[5] Stillé, Alfred: Life of John Dickinson. Quoted by Packard, History of Medicine in the United States, Philadelphia, 1901.

[6] It may be remembered that at first the University of Pennsylvania granted only the degree of M.B. in course, while Columbia University bestowed the more popular M.D. at graduation.

Morgan on his return from Edinburgh in 1765. Samuel Bard, the founder of the College of Physicians and Surgeons in New York, was likewise a student of Edinburgh.

The third feature is the early age at which men ripened into prominence and leadership. Not only was this true of medical men; it was also true of statesmen, scientists, and artists. One reason why men matured so much earlier in those days is because the institution of a rigid four years' college course had not yet attained the sanctity of a canon law or the inviolability of a constitutional enactment. Men's progress depended on their abilities and not upon the accumulation of a certain number of units of credit.

The fame of the Irish school began at about the time when that of Edinburgh was beginning to wane. What made the school of Dublin suddenly great? It was principally the work of two men, Graves and Stokes, master and pupil, who are in a large measure responsible for the type of clinical teaching prevailing in this country today. I have elsewhere sketched the history of clinical teaching;[7] how slight and hesitating its beginning in 1574, in Italy; how, after a time, it disappeared completely; how, in this country, less than one hundred years ago, men were graduated without ever having examined a patient—in proof whereof I would refer you to that most fascinating of autobiographies, J. Marion Sims's.[8] As Graves states in one of his brilliant lectures, even in France at that time the teaching in the wards was expostulatory rather than practical, the professors indulging in long harangues to large groups of students. Only in Germany did Graves find the right method employed. He even praises the gentleness and humanity of German physicians, who in their day, not to shock the patient's sensibilities, would put unpleasant diagnoses in Latin; contrary to the practice in France of discussing in the vernacular the worst possibilities in the presence of the sick man or woman. He had little patience with his own

[7] The History of Clinical Teaching, Ann. Med. History, 1920, No. 2, ii, 136–147.
[8] See also: The Great Irish Clinicians of the Nineteenth Century, Johns Hopkins Hosp. Bull., 1913, No. 270, vol. xxiv.

countrymen, who had "one language for the rich and one for the poor."

In their influence upon internal medicine in America, Graves and Stokes rank with John Hunter and Astley Cooper in theirs upon surgery. To be sure, in making this statement, I do not intend to class Graves and Stokes with John Hunter, who through his genius and originality stands by himself as the mark of an era in the history of medical science.

Graves, whom Alfred Stillé classed among the great of the earth, was the son of a clergyman, and illustrates what I have said about early maturity. At the age of twenty-four he delivered an introductory clinical lecture in which he pointed out, as one writer says,[9] those basic principles of medical education which were destined to change the clinical teaching, not only of the Dublin school, but of the medical schools throughout the world. Under the old method the majority of students never came in contact with the patients at all, but had to trust solely to their ears for information. This information was, until the year 1831—at least in Dun's Hospital—given in Latin; as Graves says, "I have called the language Latin in compliance with the generally received opinion of its nature."

It is an interesting commentary on medical examinations of the day of Graves that he states with much amazament[10] that it was not unusual for the Italian clinician, Tommasini, to spend more than two hours upon eight or ten cases. That was, of course, before history-taking had become an art; before percussion and auscultation had been incorporated into the routine of physical examination; and before the laboratory had made a place for itself in medical practice.[11]

Graves, in the Meath Hospital, taught medicine at the bedside and gave the students themselves an opportunity to examine patients. Physical examination at that time had barely emerged

[9] Kirkpatrick: History of Medical Schools in Trinity College, Dublin, 1912.

[10] Graves and Gerhard: System of Clinical Lectures, Philadelphia, third edition, 1848, p. 22.

[11] During the yellow fever epidemic in Philadelphia, in 1793, Benjamin Rush saw from 100 to 120 patients a day, not to speak of those who stopped him on the street to seek advice.

from its age-old chrysalis. Percussion was still in the hands of the few, notwithstanding the fact that Auenbrugger's great discovery was more than fifty years old; and the translation of his book by Corvisart, the method's second father, about twenty. The stethoscope was looked upon by many as a toy; even as a harmful one, as is shown in Oliver Wendall Holmes's facetious poem, "The Stethoscope." As long as the advantages of percussion and auscultation were not realized, physical examination was considered of minor importance; and just as men to-day inveigh against the laboratory as stifling the older methods of careful physical examination, so men in the day of Graves and Stokes and of Gerhard and Jackson decried the Laenneckian method and that of Auenbrugger as threatening to cause a neglect of the study of symptoms.

Graves, as well as Stokes, of whom I shall speak more fully later, while not the first to make use of bedside teaching—Boerhaave had done it a hundred years earlier—did it so consistently and so successfully that it was adopted by clinical teachers elsewhere, and especially in this country, where the lectures of Graves had been published in repeated editions and had been read with avidity. Moreover, the Americans who studied in Dublin brought back with them the methods of bedside teaching, to learn which had been, as Moreton Stillé states, their chief motive for going to Ireland.

It is hard to estimate the influence Graves exerted upon medicine in this country through the publication of his clinical lectures, many editions of which were brought out by Philadelphia publishers. Trousseau's comment on these lectures is such a remarkable tribute that it deserves to be quoted: "For many years I have spoken well of Graves in my clinical lectures. I recommend the perusal of his work; I entreat those of my pupils who understand English to consider it as their breviary; I say and repeat that of all the practical works published in our time I am acquainted with none more useful, more intellectual." What clinician is living today of whom such words of praise may be spoken?

I shall not refer in detail to the specific contributions of Graves to medicine; his name is, of course, enshrined in Graves's disease, which is described in his *Clinical Lectures*[12] and in his *System of Medicine*.[13] He points out clearly the goiter, the rapid heart, the exophthalmus, the lagophthalmus, and the nervousness.

Keen and penetrating as was the mind of Graves, he did not realize the imminence of great discoveries in the field of medicine; otherwise he would not have indulged in dangerous prophecy which led him to write as follows in the *Dublin Journal of Medical Sciences*, viii, 136: "It is true that we are—and I fear shall ever remain—ignorant of this poison (of fever). We know just as much of the nature of the febrile miasm or the virus of syphilis as was known in the very infancy of medical science; the mode in which either acts still continues among the impenetrable arcana of nature. All we can do is to observe their effects, and, from them, draw practical conclusions which may be rendered available to treatment; to study their phenomena with attention, and to employ such remedies as observation and experience have proved to be most applicable, without expecting to be able to explain their effects in the majority of instances. Fever is, in a strict sense of the word, a general disease; and there is, in the case of a fever patient, no one point on which the physician can lay his hand and say, 'Here is the local habitation of the disease; if I can succeed in removing this, I am certain of success.'" Little did he know that on the Continent Henle's scientific imagination was dreaming of a *contagium vivum;* that Virchow was patiently and quietly elaborating his revolutionary theories of cellular pathology, and that the anthrax bacillus was nearly ready to have itself discovered.

Graves's share in the differentiation of typhus and typhoid fever is, in a sense, passive and indirect. There was apparently little typhoid fever in Ireland, so that his experience was limited largely to typhus. Yet he must have seen typhoid fever on the Continent. Moreover, it is probable that cases of the disease

[12] Philadelphia, 1838, p. 136.
[13] Ibid., 1848, p. 570.

came to the Meath Hospital, but Graves, believing firmly in the essentiality of fever and looking upon fever as a disease entity, did not make the distinction drawn by others.[14]

The first to draw attention to the radical differences between typhus and typhoid was H. C. Lombard, a physician of Geneva. In two famous letters,[15] dated June 13 and July 18, 1836, Lombard pointed out the pathological and clinical differences of the two diseases. His letters apparently made very little impression in Europe, and it was left for W. W. Gerhard, of Philadelphia, to establish the differences for all time. Although Gerhard was never in Ireland, he was thoroughly familiar with Graves's description of typhus fever and used that description, as well as an experience with a few cases seen in Scotland, as the primary basis for his work. Graves, though failing to appreciate the full value of Gerhard's signal contribution, reciprocated, as did the other members of the Irish school, the good will of the American clinicians. When Gerhard published a description of typhus fever as he had observed it at Blockley, Graves at once accepted it as an accurate description of the same disease prevailing in England and Ireland. Gerhard delivered his lecture at the Philadelphia Hospital and published it in the first number of the *Medical Examiner*, a Philadelphia publication of ephemeral existence.[16]

Stokes (1804-1878) although younger than Graves, was even more conservative—probably because he came of a long line of eminently respectable ancestors. His father, Whitley Stokes, was Regius professor of medicine in Dublin for many years and a distinguished scholar in many fields. Though Stokes outlived Graves by many years, he never gave up his belief in the unity of fever—in fever as a disease with different forms of anatomic

[14] "In the whole range of human maladies there is no disease of such surpassing interest and importance as fever." Clinical Lectures, edited by Dunglison, Philadelphia, 1858, p. 254.

[15] Dublin Jour. Med. Sci., 1839, vol. xiv.

[16] Stewardson: Transactions of the College of Physicians, 1863–1874, iv, 473.

manifestations. Only one who deliberately shut his eyes to the evidence could maintain such an outworn creed.

The relation between Graves and Stokes was admirable and helped to strengthen their influence upon their immediate pupils and upon the world at large. Whenever an important issue arose —as, for instance, the defense of stethoscopic auscultation—they entered the lists together, neither jealous of the other. They must be credited in a large measure with the popularizing of the use of the stethoscope in this country as well as in Great Britain. The opposition to this instrument was more intense than anyone of the present day can conceive. Indeed, the attacks made by some contemporaries of our own upon the laboratory are but a feeble echo of the antistethoscopic storm.

As an illustration of the attitude, in the year 1838, of Graves and Stokes, and a now forgotten writer named Clutterbuck, I will quote the following letter published by the two Irishmen in the *Dublin Journal of Medical Sciences*, 1839, xiv, 138:

"Dr. Clutterbuck *versus* the Stethoscope. Dr. Hope, on Auscultation in Valvular Disease. In the heading of this notice, we have connected the names of the above gentlemen, because, although they are in no way related as authors or colleagues, they have (no doubt unwittingly) joined to injure the cause of auscultation and of science in their late publications—the one by attempting to detract from its value; the other by ascribing to it powers which it does not possess. In the *London Medical Gazette* for July 28, 1838, we have a lecture of Dr. Clutterbuck on the 'Treatment of Periodical Asthma and on Blood-letting in Specific Inflammations of the Chest.' In this lecture this irritable effusion appears: 'I may take this opportunity of adverting to the method of investigating diseases of the thorax by auscultation; that is, by listening attentively to the sounds emitted during respiration and also by sounding the cavity by tapping with the ends of the fingers on different parts of the chest. This mode of examination has always been resorted to more or less by physicians; though, from the employment of a load of new terms invented chiefly by our ingenious neighbors, the French,

and introduced by some of our own practitioners who have enjoyed the advantages of the Parisian schools, one would be led to suppose that a new region of science had been discovered, not inferior to mesmerism or homeopathy. As a specimen of the new language introduced on the occasion, I may enumerate the following, indicating, it is supposed, as many various conditions of the organs in question: Thus, in the compass of a few pages you will meet with the following: pectoriloquy, perfect and imperfect; bronchophony; pneumothorax; rhonchus; crepitation, fine and coarse; vocal resonance; tinkling echo; metallic tinkling; amphoric, or bottle-like, sound; clicking; bubbling; gurgling; snuffling; whiffs of a cavernous respiration; fistular resonance, like that of a pan-pipe or key; pectoriloquy, forming a little island of voicec—*cum multis aliis.*'

"Dr. Clutterbuck seeks to destroy the fame of Laennec by the worn-out system of denying his originality. Can he point out a single author who used auscultation as Laennec did, from the time of Hippocrates to the discovery of the stethoscope? He cannot. He is strangely ignorant, when, combining the modes of auscultation and percussion, he states that 'this mode has always been resorted to by physicians;' and his joke about auscultation as equal to mesmerism and homeopathy comes with bad grace from one himself the author of an unphilosophical and exploded theory of fever.

"But Dr. Clutterbuck is an auscultator. He can tell by 'the tone of the cough, whether there is not a great cavity in the lungs, the result of suppuration or ulceration.' He can tell with 'tolerable precision, whether a quantity of mucus lies loose and floating, as it were, in the air tubes! He can judge of the state of the larynx by the sound of the voice; and ascertain whether the lungs are pervious to air. His powers of diagnosis are certainly great; his power in chest disease must be equally valuable.

"We suspect Dr. Clutterbuck's sense of hearing must be injured; for to him, the 'ear-trumpet' magnifies but distorts the sound, rendering it less distinct than before. He holds that it may be classed with the telescope and the microscope, and in-

cludes all three in his anathema! and he adds that 'the information thus acquired, supposing it to be correct, comes too late, in general, to be of any practical use. It serves to indicate the consequences of disease, rather than disease itself; and that, at a period when they are far beyond the power of art to remedy.'

"It is not true that auscultation only detects fully formed diseases. Its chief value is the facility with which it enables us to recognize the true nature of pleurisy and pneumonia, often a few hours after they have commenced, and consequently at a time when the knowledge thus obtained leads to the almost instant arrest and cure of the disease.

"We would ask Dr. Clutterbuck whether it is of no practical use to discover an apyrexial hepatization; to distinguish between this and a circumscribed pleuritic effusion? to discover whether in a case of laryngeal disease the lungs are healthy or diseased? to distinguish between an empyema with or without a pulmonary fistule? to detect a foreign body fixed in the bronchus? to distinguish, in a case of stridulous breathing where tracheotomy is apparently called for, between tracheal disease and the pressure of an intrathoracic tumor? to detect the existence of effusion into the pericardium? or to discover latent disease of the mucous membrane, parenchyma, or serous structures in a case of typhus fever? We might add an hundred more of such instances.

"Let us be clearly understood. We write these remarks for the junior student, who might be deterred from studying an important and now indispensable part of his profession by the statements above quoted. We seek not controversy with Dr. Clutterbuck. His opinions can only affect the uninformed.

"In the next number, Dr. Hope, of whom we wish to speak with the respect which his labors have earned for him, has authorized the publication of a series of diagnoses made by his pupils after a ten minutes' lecture on the most difficult part of medicine, namely, the valvular diseases of the heart. The pupils were inexperienced and, as far as we can learn, availed themselves solely of physical diagnosis. Their conclusions in thirteen out of fifteen cases were correct; 'although they had, amongst others, to deal

with the rare diseases of the pulmonic orifice.' That the pupils, after having been instructed in Dr. Hope's views of the causes and situations of valvular murmurs, should have come to conclusions such as he would have done, is not wonderful; but that these conclusions were correct, we have only Dr. Hope's word for. We shall not examine into the evidence of the conclusions, for we know it to be insufficient; but we object to the whole proceeding as calculated to revive the often repeated and refuted objection to the advocates of auscultation, that they neglect the history of the case and vital phemomena.

"The following considerations, we wish to impress on the pupils of the Meath Hospital: First, that the physical signs of valvular disease are not yet fully established; second, that taken alone they are in no case sufficient for diagnosis; third, that even in organic diseases the nature and situation of murmurs may vary in the course of a few days; fourth, that all varieties of valvular murmurs may occur without organic disease; fifth and last, that organic disease of the valves may exist to a very great degree without any murmur whatsoever. Of this assertion, we shall hereafter bring abundant proofs. (R. J. Graves and W. Stokes.)"

Stokes had already published a small octavo volume of 239 pages, entitled, *An Introduction to the Use of the Stethoscope, with Its Application to the Diagnosis of Diseases of the Thoracic Viscera, Including the Pathology of these Various Affections.* He was only twenty-one at the time—another illustration of early maturity. This is the first work on the subject in the English language; for it he received the respectable sum of £70.

While Stokes's name will be forever remembered in connection with Adams-Stokes disease and Cheyne-Stokes breathing, his contributions to medicine are greater than is indicated by the two conditions to which his name is attached; for the English-speaking world, at least, he helped to carry on the work of Graves and to give physical diagnosis the place that it deserves in clinical medicine. This he did through his direct teaching, and also through his magnificent work on *Diseases of the Chest and Aorta*, which for its wealth of observation, its clarity and accuracy of description

constitutes a classic in medical literature. It was translated into German soon after its appearance, the translater, Gerhard von dem Busch, speaking of it as follows: "Since the publication of Laennec's great work, which formed an epoch in medical history, many valuable treatises have appeared in France and England on the same subject, but none of them can bear comparison with that which has lately emanated from the pen of Dr. William Stokes, of Dublin."

All in all, Stokes must be looked upon as a pioneer in clinical teaching and the second great cardiologist in the history of medicine, Corvisart being the first.

In yet another direction was the Dublin school a pattern for America. The first pathological society in the English-speaking world was established at Dublin in 1838, with Graves as its first president. The following year, and probably as a direct consequence of Dublin's example, a pathological society was organized in Philadelphia. This is not the one now existing, which was not born until 1857. On some other occasion I hope to give an account of the earlier society, of the existence of which I was ignorant until some years ago I found it mentioned by Pennock in his edition of the works of James Hope, and was led to trace its short career through the medical journals and other publications of the day.

I have said nothing so far of Corrigan and of Cheyne, who are also luminaries in the Irish galaxy, but who do not rank with Graves and Stokes in influence upon American medicine. Both were unusual men, nevertheless. Corrigan, by his article on "Permanent Patency of the Aortic Valves"[17] has given us an example of a classical essay produced by a man who had a hospital of but six beds to supply him with the necessary material. Although not the first to describe this disease—the French claim that honor for Vieussens; the English, for Cowper or Hodgson—

[17] Edinburgh Med. Jour., 1832.

his account is by far the best; and justice is not violated by preserving his name in connection with the disease. Corrigan also gave the first description of chronic fibrosis of the lung, which he called cirrhosis, in analogy to Laennec's cirrhosis of the liver, preferring, as he said, to "add an additional fact, rather than a new name, to our science."

Of Cheyne—he of Cheyne-Stokes breathing—little need be said with respect to the relation of Irish to American medicine. He was a good observer, but preferred a large and lucrative practice to teaching and medical writing. In consequence he had an extraordinary income during the most active ten years of his life. Then he broke down physically, and apparently mentally, giving himself over to fantastic religious and philosophical speculations.

Much might be written of the Dublin surgeons during the golden age of Irish medicine—of Colles; of Adams; of Carmichael; of Macartney; of William Wallace, who introduced the use of potassium iodide in syphilis; and of Francis Rynd, who first employed hypodermic injections for the relief of pain, using the gravity method. They were all conspicuous men, but of less direct influence upon teaching and practice in this country than their more highly gifted medical contemporaries.

Many Americans must have gone to Dublin to sit at the feet of Graves and Stokes; but although I have searched diligently, I have found definite records of only four. I am speaking, of course, of the formative period of medicine in this country. In later times, the Rotunda Hospital has probably attracted a goodly number, more for the sake of gaining a wider experience than for the purpose of getting inspiration.

The first to visit Dublin was apparently John Y. Bassett (1804-1851), of Huntsville, Alabama, whom Osler, in one of his most charming essays, has rescued from oblivion as the "Alabama Student." Bassett was a rare personality—fearless, intelligent, philosophical—who must have had a powerful influence upon

his contemporaries, but who died too young and wrote too little to have made a permanent impression upon American medicine. He went to Europe in 1836, visiting Edinburgh, Glasgow, Belfast, and Dublin, where he must have come under the influence of Graves and Stokes, and where it appears he thoroughly enjoyed himself. After leaving Dublin he spent two wretched weeks in London, made miserable by the atrocious weather. The fortnight ended, he "shook the mud of England from his feet at Dover, and departed, hoping never to be soiled with it again." He went to Paris, and, although he does not mention it, probably attended classes at La Pitié with Bowditch, Oliver Wendell Holmes, Shattuck, Gerhard, and Stillé.

It is regrettable that we know so little of Bassett. His wonderful "Credo," one of the finest things of its kind in medical literature, stamps him as a man of the loftiest ideals. This "Credo" deserves to be quoted: "I do not say that the study of nature, human and comparative, as far as it relates to medicine, is an easy task. Let anyone undertake a foreign language, and, when he thinks he has mastered it, let him go into its native country and attempt to use it among the polite and well-informed. If he succeed, let him go among the illiterate and rude, where slang is current; into the lunatic asylum, where the vernacular is babbled in broken sentences in the mouth of an idiot, and attempt to understand this. Should be again succeed, he may safely say that he knows that language. Let him then set down and calculate the cost in labor, time and talent; then square this amount, and go boldly into the study of physiology; and when he has exhausted his program, he will find himself humbly knocking at the door of the temple, and it will be opened. For diligence, like the vinegar of Hannibal, will make a way through frozen Alps. It is the 'Open Sesame' of our profession. When he is satisfied with the beautiful proportions of the interior, its vast and various dimensions, the intricate and astounding action of its machinery, obeying laws of a singular stability, whose very conflict produces harmony under the government of secondary laws—if there be

any secondary in nature!—when he is satisfied (and such are not satisfied until informed), he will be let to his ultimate object, to take his last lesson from the poor and suffering, the fevered and phrenzied, from the Jobes and Lazaruses,—into the pest-houses and prisons, and here, in these magazines of misery and contagion, these Babels of disease and sin, he must not only take up his abode, but following the example of his Divine Master, he must love to dwell there—this is pathology.

"When such an one reënters the world, he is a physician. His vast labors have not only taught him how little he knows, but that he knows this little well. Conscious of this virtue, he feels no necessity of trumpeting his professional acquirements abroad; but, with becoming modesty and true dignity, which constitute genuine professional pride, he leaves this to the good sense of his fellow-citizens to discover."

Many of us fail because "the world is too much with us." For the lonely Alabama Student, this was evidently not the case. Writing in April, 1851, shortly before his death, he says: "This world has never occupied a very large share of my attention or love. I have asked but little of it and got very little of what I asked." He died at forty-six, his work and mission unfulfilled, but assured of perpetual renown through the labor of love of Osler's understanding spirit.

Perhaps no one was more influenced by his Dublin teachers than Alfred Stillé, the last representative of a vanishing epoch whom I have seen with my own eyes. Born in Philadelphia in 1815, of Swedish ancestry, he was graduated at the University of Pennsylvania, and had the good fortune (the best of luck, Osler says) to become house surgeon at Blockley under W. W. Gerhard. He also studied with Pennock, a man whom he found of finer character, though possibly less intellectual, than Gerhard. Under these two physicians, Stillé saw typhus in Blockley. Afterward he made a special study of typhoid fever in the wards of Louis, of Paris, and had the opportunity of observing typhus

with Vulpes in Naples, Tweedie in London, Allison in Edinburgh, and Graves in Dublin. Graves made a profound impression upon him, and no doubt helped to determine his future career, sharing this influence with that idol of American students, Louis, of Paris. Stillé's writings contributed to make Gerhard's differentiation between typhus and typhoid accepted in Europe. Probably his greatest work is his essay on "Cerebrospinal Fever," based on the study of a virulent epidemic at Blockley Hospital.

Another worshipper at the Dublin shrine was Moreton Stillé, brother of Alfred, who, in the tragic unfulfilment of his ambition and in his early death, reminds one of John Y. Bassett. On starting for Europe he wrote: "I go abroad with a determination, made neither hastily nor without reflection, to be up and doing and to profit by the privilege I enjoy to the utmost. If I know myself I shall not be content with a place in the crowded middle ranks of the profession."

His plans were to pass some time in Dublin, that he might avail himself of the numerous advantages it then offered to the medical student; but more especially to improve himself in physical diagnosis, "for the cultivation of which many of its teachers were justly celebrated." The remainder of his time abroad he expected to pass principally at Paris. Unforeseen circumstances caused him to modify his plans, as his last winter was spent in Vienna.

After a winter in Dublin, Stillé repaired to London. His time had been so profitably and pleasantly spent in the former city that he left it with much regret. The circle of society into which he was admitted was not only refined and intellectual, but for one constituted as he was possessed even a higher attraction in the ease and informality of its intercourse. He had also become acquainted with several of its most distinguished physicians, among whom were Stokes, Graves, Churchill, Hamilton, Law and McDonnell, from all of whom he received many civilities

and attentions. He was in particular treated with marked kindness by Stokes, who evidently appreciated his good sense and the earnestness with which he devoted himself to his studies. In his last letter from Dublin he mentions with pride that for two of his most precious and flattering letters of introduction to Dr. Todd, of London, and M. Louis, of Paris, he was indebted to Dr. Stokes.

He had been greatly attached to Stokes, in whose society he was much thrown from his daily attendance at the hospital; in his correspondence he gives frequent utterance to an enthusiastic admiration of that great physician's character.

In June, 1849, cholera broke out in the Philadelphia Almshouse—that is, in Blockley. The care of the patients was at first undertaken by the resident physicians, but the number of sick so rapidly increased that it was considered necessary by the Poor Guardians to institute a separate cholera service. To this, Dr. Moreton Stillé and Dr. Edward R. Mayer were appointed in connection with the Medical Board, consisting of the Chief Resident Physician, Dr. Benedict, and the Consulting Physicians of the Hospital, Dr. Page and Dr. Clymer. Ten days after the commencement of his duties, Stillé was himself attacked by cholera and narrowly escaped with his life.

Moreton Stillé's fame rests chiefly on his book on *Medical Jurisprudence,* written in collaboration with Francis Wharton. It is the first American work on this subject.

In practice, Stillé failed of the success that it was his ambition to achieve. He died, a rather disappointed man, at the early age of thirty-three. His older brother outlived him nearly forty years.

Meredith Clymer, the fourth of the Dublin students, although born in England, was the grandson of George Clymer, one of the Signers of the Declaration of Independence. He was graduated from the University of Pennsylvania in 1837, at the age of twenty-one, and studied in Europe, at London, Paris and Dublin, from

1839 to 1841. Besides filling several teaching positions in Philadelphia, he was physician to the Philadelphia Hospital from 1843 to 1846, and Consulting Physician until 1852. As an index of his early ripening, I may make mention of the fact that he was editor of the *Medical Examiner* of Philadelphia in 1838, at the age of twenty-one. He resumed its editorship in 1843, on his return from Europe. He is one of the pioneer neurologists of this country. After removing to New York he limited his practice to nervous and mental diseases and became president of the Neurological Society of New York. After a very active career both in the practice of medicine and on its literary side, he died in New York in 1902.

And now, summing up in conclusion the influence of the Dublin school of medicine upon medicine in America, we find that it was exerted in two ways: (*a*) through the direct contact of the great Irish teachers with American pupils walking the wards of the Meath Hospital and Sir Patrick Dun's Hospital with them; (*b*) through the extraordinarily able books and articles from the pens of the Irish masters.

As to the result, it manifested itself primarily in the method of clinical teaching. The practice of Graves and Stokes, of having the students examine and follow the cases in the hospital, became the American method. It is the one obtaining everywhere in this country today. Incidentally the Irish school contributed to the popularization of the new methods of physical diagnosis, percussion and mediate auscultation—methods brought back to this country, in the main from Paris, by a group of brilliant young men from Boston and Philadelphia. It is quite probable that the earliest and strongest interest in the use of the stethoscope in this country was aroused by the famous essay of Stokes.

In the vivid consciousness of our obligations to Edinburgh to London, to Paris, to Vienna and to Berlin, let us not forget the more modest, yet important debt we owe to Dublin.

William and John Hunter[1]

BY THOMAS MC CRAE, M.D.

The story of these brothers reads like a romance and is unique in the history of medicine. Two young men come to London without any special advantages—except their being Scotch, which perhaps is sufficient advantage in itself—and reach the top of their profession, one at his death being the leader in his field of work and the other perhaps the foremost surgical figure in the world.

The brothers had striking similarities and perhaps equally marked differences. Both had the spirit of the investigator; both were unsatisfied if they did not see things for themselves; both were keen for facts; both were great anatomists; both realized the unity of nature and that the departments of natural history could not be separated from one another; both were great natural philosophers; both were collectors and accumulated many treasures of various kinds; both influenced medical thought and advanced knowledge; both had remarkable pupils; and both have left their names deeply carved on the tablets of medical history. They differed in their education and hence to some extent in their interests. William, with a university education and more polished in the ways of the world, showed wider interests and in addition to his medical museum had a magnificient library and a wonderful collection of coins. As has been said, "He drank the cup of intellectual life with both hands." John with little education, as the term is commonly used, was rather scornful of books and his collections were concerned almost entirely with anatomy and natural history. Nothing in nature was without interest to him.

There has been much discussion as to which of them was the greater, but such controversy does not seem worth while in view

[1] Read, November 30, 1921.

of the fact that both were great. Undoubtedly the majority verdict would be for John Hunter and there seems little question that his influence on science and medicine, using the term in a broad sense, was much greater than that of his older brother; but there seems no question that John owed much to his brother who took him to London and started him on the path which led to such great success and attainment. It seems also fair to consider that John owed a great deal to William's influence, for there is a striking similarity in their methods of work, habits of thinking, and the realization of the unity of nature. It would seem altogether probable that John absorbed a great deal of this from the older brother. Much has been made of the quarrel which parted them and its occurrence is naturally a matter of regret. At this day it seems very difficult to arrive at any absolute judgment as to where the blame should be placed; perhaps it should be divided. Reading the evidence, it has always seemed to me that the greater part of the fault was probably with John Hunter. They were reconciled shortly before the death of William Hunter.

William Hunter, born, in Scotland, in 1718, received the greater part of his education at Glasgow University, from which he carried away a store of solid scholarship. He subsequently became associated with Cullen, with whom he had evidently a very close friendship, and a plan of partnership was formed by which each in turn should look after the practice for a year while the other studied away from home. William Hunter carried out the latter part of the agreement by spending a year in Edinburgh, but in place of returning to the practice, decided to go to London in 1741. He was fortunate in being associated with John Douglas, one of the leading obstetricians in London. He aided Douglas in his studies in anatomy and in preparing illustrations for a work which was never published.

In 1748, he visited the Continent and was particularly influenced by Albinus, in Leyden, in whose work on injections Hunter took especial interest. Later he studied for a time in Paris. On his return to London, he found the field open, success came rapidly

and he was appointed physician to the court. His special success was in obstetrics, but he also practiced as a physician.

One does not feel that either of the Hunters was a man who would be satisfied with success in practice and nothing else. The greatest interest in William's life seems to have been to teach. He was first and last a teacher, beginning with lectures to naval surgeons in surgery in 1746 and later in anatomy. His last lecture may be said to have been given while he was dying. He showed throughout a complete comprehension of the unity of the laws of nature and of the importance of comparative anatomy. He was constantly carrying on investigations, of which those relating to the lymphatics, embryology, structure of the gravid uterus, and malformations may be mentioned as the most important. His work on the cellular membrane is worthy of mention. It has been said that he sometimes failed to see things but was rarely wrong in what he did see.

His interest in teaching led to the establishment, in 1770, of a school in Great Windmill Street. This was primarily for the teaching of anatomy, but in connection with it there was a large museum and a remarkable library. He made a strong effort to make the school a permanent institution—a sort of anatomical institute—but did not succeed, as the Government was not sympathetic. At this time, in London, teaching was poorly organized and the student had to receive his education in many different places. Had William Hunter's plans been adopted it might have been that around his anatomical school as a nucleus a great teaching institution would have developed.

Along with his practice, his investigations and his teaching went the habit of the collector, not only of anatomical and natural history specimens, but also of rare books and coins. The number of treasures in the library is really surprising. There are 2345 works published before 1600. The library is rich in pamphlets, records of the medical controversies of the day and in publications pertaining to American affairs, as well as in the classics and in examples of the progress of early printing.

William Hunter died in 1783, leaving his museum to his nephew,

Matthew Baillie, for twenty years, after which time it was to go to the University of Glasgow. Anyone will be richly repaid by a visit to the Hunterian Museum in Glasgow. Particular attention should be given to the anatomical specimens and especially to those concerned with the uterus. The injections are most wonderfully done and it is difficult to imagine how they could be improved upon. In recent years much has been done to put the specimens into proper condition and properly catalogue the library and collection of coins.

William Hunter's professional life was especially concerned with obstetrics and in this he rose to be the foremost authority in London. It seems curious to us to find the foremost obstetrician and one of the foremost anatomists of the day in the same man. Doubtless it was his specialty which made him take the particular interest which he did in the investigation of the gravid uterus. In this field of work he added greatly to knowledge and this is usually regarded as his best anatomical contribution. Whatever opinion we hold as to the position of William Hunter himself, there is no question of the men who studied under him. He was a "man midwife" in a sense other than that in which the term was usually employed. He brought great men into the intellectual world of medicine.

John Hunter, born in 1728 and ten years younger than his brother, had a very different life in youth. He took no interest in the acquiring of knowledge, neglected school and did not acquire a satisfactory education. All attempts to induce him to become interested in books were useless. Throughout his life he jeered at book-learning and gloried in the fact that he had kept free of it. One cannot help feeling that sometimes under this lay a deep regret for his lack of education. There may have been other reasons, however, for his rather biting comments on book-learning, because many of the profession of that day knew little else and were more concerned with what had been written about disease than what they could observe themselves.

John Hunter's lack of general education undoubtedly affected his literary output, but in no way influenced his powers of observation and investigation. For him investigation and the collection of facts were all important; teaching apparently did not especially appeal to him, at any rate in the form of lecturing, and an early invitation from his brother William to give lectures on anatomy was declined. In later years his lectures on surgery were a trial to him and he apparently never became fluent in delivery.

He came to London, in 1748, at the invitation of his brother and at first was associated with him in his anatomical work. This opened up new interests for him, and for the rest of his life he was constantly engaged in investigations and trying to find out new things. He worked energetically at anatomy and did some hospital work under Cheselden and Pott. The next year he was giving demonstrations in anatomy, a testimony to his ability and industry. In the next few years he attended the hospital practice of Cheselden, and later, at St. Bartholomew's, he studied under Pott. In 1754 he entered St. George's Hospital, with which he was associated for the rest of his life. William had plans to make up for John's lack of education and persuaded him to go to Oxford. But to the investigating mind of John Hunter, Oxford held no attraction and his stay was brief. The Oxford atmosphere of that day was not a congenial one for a man of Hunter's interests.

In 1756 he was appointed house surgeon to St. George's Hospital, but held the post for a few months only. During this time he was improving his knowledge of human anatomy; but evidently the realization that this was only a part of comparative anatomy came to him and he widened his field of work. With this was joined the study of physiology and the desire to associate the study of function with that of structure. This is an outstanding fact in Hunter's work—the importance of physiology and the value of the study of principles, so strongly illustrated in his later surgical work. Comparative anatomy became one of his great interests; animals from menageries or anywhere else,

whales, birds and fish were sought after. There are many curious accounts of his experiences in obtaining specimens. The practice of surgery had compensations in that it provided the means of acquiring more specimens.

Ill health came later, and for the purpose of change, in 1760, he entered the army and saw service abroad. This experience was not wasted time; he continued his studies in natural history and laid the foundation for his work, *Treatise on the Blood, Inflammation and Gun Shot Wounds.* On his return to London, in 1763, he began the practice of surgery with prospects which could not be considered as encouraging. There was no lack of good surgeons. He was more interested in scientific work and was known as an anatomist, while he regarded surgery more as a means to an end. His saying, "I must go and earn this damned guinea," has become one of the favored expressions of the profession. There must have been many guineas, for very soon he established a "laboratory" outside of London. This was "a farm, a menagerie, an institute of anatomy and physiology, and a villa." Dens for dangerous animals, ponds for fish and aquatic life, stables, kennels, cages and hives, were among the diverse furnishings of his estate. The tenants were as diverse. The study of bees engaged his attention for many years.

Success in practice came slowly, but in 1768 he was elected a surgeon to St. George's Hospital, an appointment of the greatest advantage to him. He was able to take "house pupils," among whom were Physick, of Philadelphia, and Edward Jenner. In 1773 he gave his first course of lectures on surgery, but lecturing was never easy for him and cost him much in labor and anxiety. They were new lectures on surgery, for they dwelt on principles rather than practice. Embryology, physiology, pathology and a discussion of the processes of disease and repair were included. But hard common sense was not lacking and always the value of experiment insisted upon, as shown by the celebrated advice to Jenner, "To try and not to think." The days were too short for his labors; one is appalled by the account of what he accomplished. He did an enormous number of dissections and post-

mortem examinations himself and must have dissected thousands of animals. He had original records of the dissection of 315 different species of animals. His letters are full of appeals for specimens and for reports on points in natural history.

The death of Pott, in 1788, left Hunter at the head of the surgical profession. Professional honors had come to him in full measure. But nothing interfered with his work; the learning of new things by observation and experiment was his passion. He died in harness and "with his boots on," which has been termed the death of a gentleman. The occasion was a tragic one. There was a dispute at a meeting in St. George's Hospital over a matter near to Hunter's heart. His anger brought on an attack of angina pectoris, from which he had suffered for many years, and the end came at once at about the same hour as Marie Antoinette was beheaded in Paris.

His museum remains as a magnificent memorial. It was purchased by the Government and given into the custody of the College of Surgeons. It contained over 13,000 specimens. The museum and library are in the College building in Lincoln's Inn Fields.

To sum up John Hunter's many qualities and activities is difficult. He was a great investigator, an accomplished naturalist, a skilful anatomist, a physiologist, an experimental pathologist, an original thinker and, perhaps greatest of all, a stimulator of thought. He may well be regarded as the founder of scientific surgery, and well did Sir William Osler say that he "combined the qualities of Vesalius, Harvey and Morgagni."

To estimate the extent of the influence of the Hunters on American medicine is difficult. There are grateful references in letters to the advice given by William Hunter on the establishment of medical schools in this country. Many Americans studied in London under the Hunters; two should be mentioned —William Shippen, Jr., who gave the first course of lectures on anatomy in Philadelphia, and Philip Syng Physick, one of the most brilliant of early American surgeons. But the influence

of the work and teachings of the Hunters must have been greater than can be stated in set terms.

Every medical man who visits Great Britain should make a point of visiting the museums left by the two brothers. The collection of William Hunter is at Glasgow University and that of John Hunter in the College of Surgeons in London. The work of their hands is there for him to see, and speaks, perhaps more plainly than their words could have done, of what they accomplished.

THE ACHIEVEMENT OF THE ARMY MEDICAL DEPARTMENT IN THE WORLD WAR IN THE LIGHT OF GENERAL MEDICAL PROGRESS

The Mary Scott Newbold Lecture
Lecture IV[1]

BY MERRITTE W. IRELAND, M.D.

SURGEON-GENERAL, UNITED STATES ARMY, WASHINGTON, D. C.

Whatever is due to the Medical Department of the United States Army for its achievement during the recent war may be credited to the training and experience of its regular personnel on the administrative side, and to the generous and efficient coöperation of the physicians and surgeons of this country on the professional side. When we entered upon this war every military man in the country realized that we were unprepared for it. Not that the possibility of getting into a war of such dimensions had been ignored by officers of the army, who in fact, with but small encouragement, had done everything humanly possible to be ready for the emergency; but the fact has developed that every modern war of magnitude requires national as well as military mobilization. When we got into the European war everyone was made to realize that the whole nation was at war, as had been true of all the countries then engaged in the tremendous struggle.

To be unprepared for war, under any conditions of space or time, seems to be the chronic state and fate of all republics and democracies from Athens down. Anglo-Saxons, familiar with the dubious policy of "muddling through," are prone to regard

[1] Read February 4, 1921.

this condition with cheerful cynicism as a racial or national trait. But there is a sentence of the great Napoleon which sheds light on the matter, drawn as it was from an experience with military affairs unparalleled in history: "Three-fourths of mankind," Napoleon said, "never do the necessary things until occasion arises, and just then it is too late." Human nature, in other words, is little inclined to put restraint upon itself and go through what seems tedious and disagreeable to attain an important end, except under compulsion, through training and discipline, or under stress of impending emergency, when, as Napoleon observed, it is usually too late. Left to themselves, our children would scarcely acquire any education worth considering. We owe that to the school-teacher. And so it is with nations, once defined by an eminent statesman as "great, simple-minded children." What scientific men have told us about crowd psychology and group psychology will but confirm this view, that even large nations, without the self-direction and self-discipline that comes from training, may be, in wartime, like helpless, defenseless children. Like the Athenians, we, too, have prided ourselves on our democratic mode of government; that "in election to public offices we consider neither class nor rank;" that "we stand chiefly in fear to transgress against the public and are obedient to those who are for the time in office;" that in war "we trust not to secret preparation and deceit, but to our own courage in action." In the great war we have just passed through, our men in the trenches gallantly sustained the reputation of the American soldier. Our troops first got into mass action on the morning of May 28, 1918. Less than six months later our share of the work was over. The proverbial luck of young nations was with us. But fortune is uncertain, and it behooves us to be more wary as we grow older. I hope to show, in this brief sketch, that, for the medical profession at least, war has been a very efficient schoolmaster.

Medical Administration. On the side of medical administration, we entered the European war with much better pre-

paration than had been the lot of our forces in either the Civil War or the Spanish-American War. Our memorable experience with typhoid fever during the Spanish-American War taught its lesson and pointed a useful moral. The lesson was the old and often reiterated lesson of the past, that infectious diseases are more dangerous to fighting armies than the bullets of the enemy. The moral was that what is called medical administration in armies must be permitted to work untrammeled, with the generous support of both the medical profession and the line of the army itself, if we are to operate against these diseases with the same efficiency that well-trained military forces operate against the enemy. When, at the close of the Spanish-American War, the lengthy investigation of the Dodge Commission explored the causes and prescribed the remedies for our deficiencies in medico-military administration, the matter was taken very seriously to heart by the late General Robert M. O'Reilly, who devoted his whole administrative period as Surgeon-General of the Army to correcting these defects and to doing his uttermost to make our Medical Corps a highly efficient military machine.

Not to take up time with all the recommendations of the Dodge Commission, I will briefly say that what an army mainly requires, in peace or war, is personnel and material supplies, including food and shelter. With adequate equipment and efficient personnel, almost anything can be accomplished. On the side of matériel, General O'Reilly enabled us to equip our field hospitals and sanitary organizations more rapidly than they could be organized as to personnel. On the side of personnel, he created the Medical Reserve Corps, through which device the Medical Department acquired over 30,000 officers from the civilian profession for the recent war. In such matters as the introduction of anti-typhoid vaccination and the aid given to Prof. Chittenden, of Yale, in his experiments on the physiologic economy of nutrition, General O'Reilly upheld one of the time-honored traditions of the Army Medical Department from the days of Beaumont down, namely, the encouragement of scientific research.

When we entered the European war, our army existed mainly

on paper, as "tables of organization," blank forms to be filled in as to personnel and matériel on occasion. In the Texan mobilization we had, for the first time since the Civil War, a mobilized division in the field. This required the organization of certain sanitary field units, and these detached nuclei proved to be starting points for the development of the complex system of sanitary formations required in the World War. As a result of the recommendations of the Dodge Commission, a full year's supply of medicines, hospital appointments and nonperishable stores, adequate for an army of about 300,000 men, had been accumulated and laid by; and fifty base hospital units had been organized by the civilian profession in different cities, through the Red Cross, and under direction of Col. Jefferson R. Kean.

On our entry into the war, then, we had already a fair start in the matter of equipment and medical supplies, for which Congress subsequently appropriated more than half a billion dollars for the use of the Medical Department during the war period. Largely through the mobilization of the Medical Reserve Corps, the personnel of the Medical Corps was increased by November 30, 1918, to 30,591 medical officers, and 264,181 enlisted men, an organization one and one-third times the size of the whole Regular Army of January 1, 1917. The commissioned Ambulance Service was increased from zero to 209, the commissioned Veterinary Corps from 62 to 2002, the commissioned Dental Corps from 86 to 5937, the commissioned Sanitary Corps from zero to 2919, the Army Nurse Corps from 403 to 21,480. The Surgeon-General's Office at Washington, which, on April 6, 1917, consisted of the Surgeon-General, his staff of six officers and 149 civilian employees, became, at the height of the war period, an organization of thirty administrative units, with a personnel of 262 medical officers and 1889 civilians. Yet the total expenditures of the Medical Department up to April 30, 1919 ($314,544,000), were two hundred million dollars less than the actual appropriation for supplies, and only 2.2 per cent of the total expenditures of the entire Army.

CARREL-DAKIN TREATMENT. Thus, by the time our troops got into active operations, we had the sinews of war, supplies and

personnel, and the additional advantage of the sanitary experience already gained by our allies at the front. As you know, this was the first war in history in which the mortality from battle casualties exceeded that from communicable diseases. The first and most important changes in military surgery were therefore centered on wound treatment. In 1914, operative surgery was entirely aseptic. But, with the dirt and grime of trench warfare, over ground cultivated for centuries, and therefore swarming with pathogenic organisms, asepsis was no longer possible and the revival of the antiseptic surgery of Lister was almost a foregone conclusion. As described by Crile[1], the early status of wound treatment on the Western Front was haphazard and experimental, a matter of dispute between "the claims of the value of various chemical agents against those of no chemical agent; of moist dressings against dry; of hot against cold; of frequent dressings against infrequent, and of no dressings against both; of sunlight and of electric light against occlusions; of immersion against hot air; of bacteriological control against clinical judgment; of vaccines, toxins and foreign proteins against normal reaction; of wound inoculation with harmless organisms against wound sterilization; of isotonic against hypertonic solutions; paste has competed with paste, bipp with ip, sap with both and chronic pastes with all."

Out of all this controversy and welter of opinions, there was at last evolved one of the great surgical discoveries of the war, the application to wound treatment of the principle of disinfection by the release of a gas from a liquid solution. Of this method, the Carrel-Dakin, Finney[2] says conclusively that "it is one of the most important and far-reaching contributions of the war to the armamentarium of the surgeon." As Keen[3] says: "Lister taught us, above all, how to prevent infection; Dakin and Carrel, following Lister's principles, have taught us how to conquer even rampant infection. For nearly half a century we surgeons

[1] Tr. Am. Surg. Assn., Philadelphia, 1919, xxxvii, 35.
[2] Tr. Cong. Am. Phys. and Surg., New Haven, 1919, xi, 15.
[3] The Treatment of War Wounds, 2 ed. Philadelphia, 1918, p. 75.

have been fighting firmly intrenched infection, but always in vain. It required the stern stimulus of war to enable us to win the victory."

Now, although the physico-chemical principle involved was familiar to us in ordinary commercial chloride of lime sterilization or in antiseptic throat pastils, the Carrel-Dakin method had a long foreground and thereby hangs a tale. In his Mütter lecture delivered before this College in 1902, the late Col. Louis A. La Garde demonstrated that the pathogenic organisms in powder or on projectiles are not destroyed by the heat of firing but are carried directly into the wound. We have to reckon, then, with the fact that there is no such thing as a sterile battle wound. Now, the wounds from high explosive shells and other great missiles used in this war differed from those of any other war, not only in the frightful laceration of the tissues, but in the fact that the whirling, vibratory motion of the projectile completely devitalized such tissues, converting them into ideal culture media for the pathogenic microörganisms carried into them. In the first year of the war, the base hospitals were full of such septic wounds, which had developed during the time required to transport the wounded back to base for treatment. Necessity is the mother of invention, and the necessity for the Carrel-Dakin treatment was created by a military principle. That principle was the rapid evacuation of the wounded from the firing line, with the utilitarian non-medical aim of relieving the fighting forces of encumbrance and of returning those recovered from wounds to the firing line as soon as practicable. As humanitarian physicians, it grieved us to see our soldiers die from septic wounds, and it was our bounden ethical duty to save their lives; but as military officers, we could not afford to let them die, for the issue, at the time, was uncertain, and the odds were tremendous. To make this great salvage service efficient and effective, centers of triage were established and surgical service was pushed up to the front, so that the Carrel tubes could be inserted in the wounds before evacuation to the rear. The effect on wound treatment was miraculous. Part of Carrel's treatment was the mechanical

cleansing and removal of débris and of loose devitalized tissues from the wound. From this, it was but a step to débridement, or complete excision of the devitalized tissues by the knife, a kind of mechanical asepsis evolved by Gale and Lemaître. Of 206 gunshot wounds treated in this way in Evacuation Hospital No. 2, Col. Brewer records that 93.5 per cent healed without infection or suppuration. It was these two principles of wound treatment which enabled us to return such large percentages of our wounded to the front for duty. Of the advantages which were ours in this respect, Brewer[1] has spoken forcibly:

"It was fortunate for our men that we did not have to go through these two or three years of experimental work where so many died and so many suffered intensely, and where the results were so unfortunate. We were able to begin where they left off, and it is to the hearty and cordial coöperation of the French and British medical services that we owe this. Our men, as soon as they came over, our splendid surgeons that volunteered in such large numbers at the beginning of the war, were taken in by the French and British surgeons, given work to do, and everything possible was done to facilitate their work. As a result of that, last January when our forces began to go into the lines, and we established our advanced evacuation hospitals, we were able to employ surgical teams of not only some of America's most distinguished surgeons, but of those who had the inestimable advantage of having worked with the masters of surgery of the French and British armies."

I have dilated on these methods at the start, because we may not enjoy this advantage a second time, and because these surgical principles, the most important which came out of the war, need not be lost to civil surgery, but may indeed be of the highest practical value in industrial and railway surgery. The rest of our war surgery, even the orthepedic and maxillo-facial, was mainly an extension of principles already well established.

Problems of Transportation and Treatment. We sailed for France with General Pershing, May 28, 1917. The first duty

[1] Monthly Bull., Chamber of Commerce, New York, 1919, x, 40–41.

of the Medical Department was to provide ways and means for hospitalization of the sick and wounded. This was a long and tedious process, never fully realized, but in process of realization at the end of the war, when our program was for 500,000 beds. On May 15, 1918, thirteen days before our First Division captured Cantigny, there were 30,187 hospital beds available. On the signing of the Armistice (November 11, 1918), we had available in France for an army of a mean total strength of nearly two millions, 261,403 beds, in 153 base hospitals, 66 camp hospitals and 12 convalescent camps. The total number of patients in hospital on that day was 193,448, of whom 94,405 were sick, and 99,043 wounded. The total number of beds in the home territory was 121,883, with 69,926 patients, or a grand total of 353,887 hospital beds in France and the United States, as against a maximum of 118,057 beds for the Union forces in the Civil War. Most of the large hospital centers in France, such as Allerey, Bazoilles, Toul, Mesves, Mars and Savenay, were made up of units of 1000 bed hospitals, barrack type, with a crisis expansion of 2000, so that the total bed capacity of the centers was ultimately to be from 10,000 to 40,000 each. One of the centers had 22,500 patients when the Armistice was signed. Through the courtesy of the French authorities, many separate buildings were acquired, such as the *casernes* at the Toul center (15,000 beds) or the hotels at the Vichy center (10,000 beds). Hospital construction in France was done by our Corps of Engineers, who had even to cut the timber and saw the lumber.

Although the humanitarian element in evacuation of the wounded is subordinated to its military purpose, yet the wounded soldier's chances of recovery are better furthered by business efficiency and military promptitude in evacuation than by misdirected sentiment or wrong-headed philanthropy. The underlying military motive is kindlier than the ancient or Turkish plan of having no medical administration in campaign whatever, leaving the wounded to die in their tracks. There were physicians who complained that they were utilized as packing clerks at the front, but it is just this sort of administration which brings the wounded

man safely into the hospital, with a clear statement of the nature of his injury. Evacuation on the Western Front was a complex and sometimes desperate matter, often hampered by lack of transportation facilities, by the impassable conditions of roads boggy with mud or crowded with other vehicles, and by the generally torn-up condition of the combat areas. It required the prompt mobilization of every kind of vehicle, such as ambulances, motor trucks, lorries and other rolling stock attached to the sanitary formations which move forward with the fighting divisions, as well as the establishment of evacuation hospitals and rest stations on the line of communications and of base hospitals and convalescent camps in the zone of the interior, with their own type of transportation, including ambulance service, hospital trains, hospital barges and hospital ships. In spite of delays in construction, we had, on November 11, 1918, twenty-one hospital trains of sixteen coaches each, about sixty hospital barges, and some 7375 ambulances of heavy and lighter type. Up to November 11, 1918, 129,997 sick and wounded had been evacuated by our hospital trains, and 197,708 in the fifty trains lent by the French, while from the embarkation ports there were evacuated by ship to the United States 15,853 patients up to November 11, 1918, and 83,642 up to March 1, 1919.

To the sanitary administration on the Western Front, in other words, to the military application of preventive medicine, was due our relatively small disease incidence as compared with earlier wars, and this in spite of the long period of exposure before our troops got into action. The management of the sick and wounded records, the services of epidemiology, laboratories, food inspection and food economics, sanitary inspection and venereal prophylaxis were of the highest order of efficiency, and with these services the names of Siler, Zinsser, Emerson, Young, Keyes, Walker, in the war zone, and of Reynolds, Howard, Chamberlain and Russell in the home zone will always be associated. In spite of repeated cabling we never got all the personnel and supplies needed in crucial situations, which had to be met and eked out by robbing one organization to supply another, and by the self-sacrificing

fulltime and overtime service of operating surgeons, nurses and hospital personnel. Many hospital nurses worked from fourteen to eighteen hours daily for several weeks running. Some surgeons worked from forty-eight to seventy-two hours without sleep. One roentgenologist dropped unconscious by his machine after operating it for forty-eight hours. Litter-bearers were sometimes so exhausted that they could not lift their hands above their heads. Promotions recommended for deserving medical officers were held up indefinitely, and did not reach them overseas until the cessation of hostilities, when they were, in the Napoleonic phrase, too late.

Results. So much for the means at our disposal. The results attained in hospital treatment were remarkable. Of the 2,039,329 men who reported in France, about 1,300,000 were combatant troops; and of these, twenty-eight divisions, or about 784,000 men, got into action. Our total casualties were 318,993, of which number 34,249 were killed in action, 50,714 died from disease, and 13,691 (6.11 per cent) died from wounds out of 224,089 wounded, of whom 158,595, or 70.77 per cent, were returned to duty. We can best appreciate the advances made in wound treatment and the therapeutics of disease by comparing our results in hospital with those of the Civil War. Although our maximum total strength in the World War on October 11, 1918 (3,551,447), was nearly four times greater than that of the Union forces on January 1, 1863 (914,447), yet, covering the same relative period of time, 44,238 men (14.5 per thousand) were killed in action in the Civil War as against 34,249 (11.26 per thousand) of our troops in the World War; 246,712 (80.87 per thousand) wounded were treated in hospital in the Civil War, 224,089 (73.66 per thousand) in the World War; 31,978 (10.48 per thousand) died from wounds in the Civil War, 13,691 (4.5 per thousand) in the World War; 186,216 (61.04 per thousand) died from effects of diseases in the Civil War, and 50,714 (16.67 per thousand) in the World War. Thus, although the Union Army of the first two years of the Civil War was one-fourth the size of our mobilization in the World War, nearly 10,000 more men were killed outright in the Civil War,

more than 22,000 more men were wounded, more than twice as many died from wounds in hospitals, and nearly four times as many died from the effects of disease.

As given by Lieutenant General von Schjerning, the total losses of the German Army during the four years of the World War, with a mean average strength of 4,257,720, were 1,531,048 killed in battle, 4,211,269 wounded, and 155,013 died of disease out of 19,461,265 admissions to hospital. As given by General Sir John Goodwin, the total losses of the British army, exclusive of the Indian and African troops, were 569,143 killed in action, 170,509 died from wounds, 83,975 died from other causes, 1,025,808 wounded, and 143 missing. Including the Indian and African contingents, the total losses, including 929,812 deaths from all causes, 2,097,994 wounded and 3467 missing, amounting to 3,051,273.

Judging from our own figures, and considering the terrible effects of heavy artillery and high-power explosives, our capacity to heal wounds has increased twofold and our ability to treat disease fourfold. We can form no judgments from the German figures, because they have not yet given the numbers who have died or recovered from battle wounds, while their figures of nearly twenty million admissions to hospital are not the same thing as the actual number of patients admitted. In ability to prevent disease we have made gigantic strides since the Civil War. Between September 1, 1917, and May 2, 1919, we had 213 deaths from typhoid fever; had the Civil War rate obtained we should have had 51,133 deaths, and had the Spanish-American War death rate obtained, 68,164. We had thirteen deaths from malarial fever in the World War; with the Civil War death rate we should have had 13,591, and with the Spanish-American War rate, 11,317 deaths. In the World War we lost only forty-two men from dysentery; with the Civil War rate we should have lost 63,898, and with the Spanish-American War rate 6382. Our mortality from tuberculosis in the World War was 1220; with the Civil War death rate it would have been 9574. We lost only five men from smallpox in the World War, but with the Civil

War death rate we should have lost 9536. On the other hand, 41,747 soldiers died from pneumonia in the World War, while with the Civil War death rate this mortality would have been 38,962 and with the Spanish-American War death rate, 6086. The high mortality in the World War is to be explained by the unusual malignancy of the pneumonias following the measles epidemic of 1917-1918 and the great influenza epidemic of 1918-1919. The most difficult problem facing both military and civil sanitarians is the prevention of the sputum-borne infections.

Our success in wound treatment was due to the high efficiency and promptitude of our surgical service in carrying out the Carrel-Dakin treatment and the method of wound excision with primary suture. The highest incidence of war wounds in our hospitals occurred during October, 1918, the period of the Argonne fighting, when 38.37 per cent of admissions to hospital and 41.52 per cent of deaths were from gunshot and other wounds. Our percentages of admissions and deaths from gunshot wounds during our entire six months of fighting were 33.42 and 54.29 respectively. Wounds from small arms and those incurred during air attacks had a higher case mortality than wounds from missiles, while recovery was the rule in cases of gassing. The case mortality from gunshot wounds was 8.26 per cent, that from gassing 1.73 per cent. Wounds from missiles were most frequent in the lower and upper extremities and the chest, being sustained in going over the top. The percentages of admissions and deaths from wounds of the lower extremities were about equal.

More men were killed outright through abdominal and pelvic injuries than through any other. More than twice as many were killed through head injuries as were admitted to hospital, and nearly seven times as many through wounds of the spine, abdomen or pelvis. All this is to be explained by the terrible mangling of the body from high explosive shells and projectiles of large caliber. Wounds of the spleen, intestine, pancreas, stomach, kidney, liver, esophagus and bladder show the highest case mortality in the order named, both in the World War and in the Civil War. Men thus wounded seldom recovered, because the destruction

of these viscera was beyond the reach of surgery; but although visceral wounds were almost hopeless in both wars, we have astonishing evidences of improvement in the treatment of gunshot fractures in the World War.

The comparative percentages of case mortalities in the Civil War and the World War are for gunshot fractures of the tibia and fibula as 26.19 to 13.74; of the humerus as 20.70 to 9.04; of the clavicle and scapula as 13.90 to 6.98; of the radius and ulna as 9.40 to 3.98; of the wrist as 12.10 to 1.80, and of the foot as 7.70 to 2.77.

Casualties. The number of casualties among our medical officers in France from July 1, 1917, to March 13, 1919, was 442, and of these, 46 were killed in action, 4 were lost at sea, 212 were wounded, 22 died of wounds, 101 died of disease, 9 died of accidents, and 7 were reported missing in action. While our infantry sustained the greatest number of casualties, namely, 215.66 per thousand wounded, and 12.77 per thousand killed in action, the Medical Corps comes sixth on the roll of honor, following the artillery with 25.67 per thousand wounded in action and 1.62 per thousand killed. That the number of killed and wounded in our Medical Corps (258) is more than one half of its total casualties (442) and that the number who died from disease (101) is almost one-fourth, is sufficient evidence of the readiness with which our medical officers exposed themselves to fire and ran the risks of infection in hospital. The first American soldier who was killed in France after our entry into the war was a medical officer, Lieutenant William T. Fitzsimons, whose life was lost during an air attack on the base hospital group at Dannes Camiers, September 4, 1917, and in honor of whom our Army General Hospital at Denver has just been named the Fitzsimons General Hospital.

Prevention and Treatment in Home Territory. In the home territory, excellent administrative work was done from the start in the all-important matter of raising personnel and supplies, and in providing adequate hospitalization and sanitation for our thirty-two army camps, some of which were great communities of between 40,000 and 50,000 population. The purchase of vast

quantities of supplies, some of which had to be manufactured on a large scale for the first time in this country, the distribution and shipping of such supplies through supply depots, and the financial accounting for these was a large achievement, which will form an important chapter of our Medical History of the War. Some of the camps were badly chosen as to site, and the base hospitals in many of these camps were the last structures to be put up, so that division surgeons and the commanding officers of these camp hospitals had an uphill fight of it during the measles and meningitis epidemics of the severe winter of 1917-1918, and even more arduous experiences with the epidemic of Spanish influenza of 1918-1919. In this war, we first learned to go after the sources of disease instead of waiting for it, through a gradual realization of the fact that the individual, particularly the individual carrier, is more dangerous than the disease itself. The isolation of contacts and suspects, as well as of carriers, in such communicable diseases as measles, meningitis and influenza, although not a new feature in military or civil sanitation, was first carried out on a large scale in this war.

The Division of Sanitation in the Surgeon-General's Office had work of the most varied kind, from the extermination of mosquitoes to the preparation of our statistical records. This part of our service profited much by the experience and wise counsel of such experts as Welch, Vaughan, Zinsser and Emerson, and it is no exaggeration to say that those who served with us acquired fresh ideals of group sanitation and group medicine through actual contact and experience with the hygienic requirements of large military communities, under constant discipline and of uniform type. Food inspection and food economics were administered from the point of view of modern nutritional science by expert metabolists. The admiristration of our surgical service was greatly forwarded by the work of such men as Charles and William Mayo, Finney, Brackett, Cushing, Goldthwaite, Crile and Brewer; our medical service by Thayer, Janeway, Longcope and Conner; the service of ophthalmology by Greenwood, de Schweinitz, Wilmer and Black; the service of otolaryn-

gology by McKernon, Mosher and Richardson. Reconstruction, gas defence, the physiologic requirements in aviation and the psychologic examination of drafted men come up as entirely new subjects in military administration. Although the orthopedic or instrumental phase of reconstructional surgery of disabled soldiers had been blocked out in Germany ten years before the war and practised here and there in civil life, the program was soon expanded to include reëducation, or the vocational training of the disabled, including the blind and the deaf; rehabilitation, or the social adjustment of the disabled to suitable employment, and the education of the public to a proper attitude toward the crippled soldier, as voiced in the utterance of Michael Dowling, a reconstructed civilian, at the session of the American Medical Association in 1918: "Every community and every family ought to see to it that every other member of the family pays no attention to a hunchback; never looks at a man with club-foot as he walks down the street, especially never looks at his deformity; and never looks at a man with a peg leg or with an empty coat sleeve. It should be taught in the schools. It should be preached from the pulpits." With this phase of administration we associate the names of Frank Billings, Richardson and Wood.

The application of the newer findings of psychology, neurology and psychiatry to the examination of drafted men by Salmon, Bailey and Yerkes demonstrated the existence in our recent population of large numbers of people with weak, undeveloped or disordered minds. Mental tests of children had been employed in the schools, but they were first tried out on adults in mass during our recent mobilization. Mental defectives will be bad risks in any future army. The soldier of the future must be of active mind as well as body. His wits and senses must be something better than a baseball player's. Under the recent program our prospective army will be a school in which the mind and the senses are trained to coördination through vocational adaptation to suitable employments. Although we were engaged less than twenty months in the war, the scientific achievement of our medical officers in that short time was considerable. What was

accomplished reflects the highest credit on our American profession. Through the labors of MacCallum, Cole, Dochez, Avery, Bull, Miller, Capps and Irons, the pneumonias consequent upon different infections were studied pathologically and typed as to bacilli. Streptococcus hemolyticus infection was investigated by Avery, Kinsella and Swift; the surgical aspect of the empyemas by Dunham, Bell, Graham, Kinsella and Stevens of the Empyema Commission of the U. S. Army; measles by Sellards, Bigelow and Fox; meningitis by Flexner and Herrick; influenza by Cole, Avery and Jacobs; parotitis by Sailer; bronchopneumonia by Miller; tuberculosis by Bushnell; anthrax by Pearce; erysipelas by Kanavel; arthritis by Pemberton, and parasitic infections by Kofoid. The hypothesis that trench fever is a louse-borne infection, which originated with the British commission under General Sir David Bruce, was carried to successful demonstration by the American commission under Richard P. Strong.

Generally speaking, the prevention and treatment of disease was of greatest moment in our camps in the home territory, while the transportation and treatment of the wounded occupied us mainly in the war zone. I have already spoken of the relation of the concept of transportability to successful wound treatment. On the Western Front this was vastly forwarded by the adoption of the principle of continuous extension by means of the Thomas and Hodgen splints and the Balkan frame. Of outstanding practical importance was the work of Blake, Goldthwaite, Osgood, Allison and Keller on gunshot fractures and the standardization of splints. My time limits prevent more than passing mention of the brilliant work of Cannon, Porter and Crile on wound shock; of Cushing on brain surgery; of Hayes, Hutchinson, Powers and Blair on maxillo-facial surgery; of Yates and Lilienthal on surgery of the chest; of Salmon on war neuroses; of Warthin, Winternitz and Underhill on the pathology of war-gas poisoning; and of Christie, Johnston, Case, Cooledge, Shearer and Manges in röntgenology.

Education and Training. On the score of training, instruction was given to volunteer medical officers in all branches of military medicine and surgery at the Medical Officers' Training Camps in this country, at the Rockefeller Institute, at the Army School at Langres, in the special courses instituted by the administrative divisions of the Surgeon-General's Office in our larger cities, and through the generous coöperation of such great leaders as Sir Robert Jones in England and Depage at La Panne (Belgium). Our Medical Officers' Training Camps brought out some defects in medical education in this country and, on the administrative side, the most valuable lessons which our army has learned from the European war have been in this matter of education and training. From the great training areas in France came the idea of training in corps areas in this country; from the training camps in this country we have learned that medico-military or other training should not be too generalized as to subjects or too extended as to time, but should be concentrated on particulars of immediate practical importance. From the useful and valuable lists of the qualifications of civilian practitioners furnished us by the American Medical Association and the Council of National Defence during the mobilization of the Medical Reserve Corps, we have learned the value of coöperation with the medical profession in relation to any future mobilization for war. The expensive and valuable scientific work done for the Army by the Rockefeller Institute, the Carnegie Institution of Washington, the National Research Council and the Public Health Service is a guarantee of the coöperation and team-work which the government may hope for in any future emergency.

Program for the Future. I have now endeavored to tell you, in brief space, what the Army Medical Department and the medical profession of the country have accomplished in the recent war. A word as to the future. It is the purpose of our army establishment to make its future program of training educational in the broadest sense. Modern armies require not only fighting men but also skilled mechanics, artisans and craftsmen of all kinds. In future, the Army proposes to train such men

within the ranks. This is one of the most important things that has come out of our experience in the European war. Hereafter, the enlisted man will have full opportunity to learn a trade and to join the ranks of skilled workers in the world. If he belongs to the unskilled classes, when he leaves the Army, it will be his own fault. If he accepts his Army training in the right spirit, he will acquire a definite means of acquiring a livelihood, of supporting a family and of becoming a respectable and useful member of society. As blocked out on the Army job sheets, this training will be intensive and scientific, not the haphazard and ill-considered training which the journeyman plumber's or steam-fitter's apprentice too frequently gets from the boss. In like manner, it is incumbent on the Medical Department not merely to institute educational training of enlisted men as clinical clerks and surgical dressers in the hospital, but also to train specialists among our commissioned personnel in all the important branches of scientific medicine. In the medical establishment of the British Army, steps have already been taken in this direction by the appointment of whole-time chiefs of surgery and pathology. In the contemplated enlargement of the Walter Reed Hospital, we shall have an establishment at which this program can be carried out by our Army Medical School in full measure. The older, archaic army of the small, scattered and isolated posts disappeared with the European war. A newer army, of large corps areas, has taken its place. I think you will admit that a nation of more than a hundred million people needs such an army, and that its medical department should have educational facilities at least comparable with those of Netley and Val de Grâce.

In pleading the case of American liberties before the English Parliament in 1775, Edmund Burke said: "It is the love of the people, it is their attachment to their government, from the sense of the deep stake which they have in such a glorious institution, which gives you your army and your navy and infuses into both that liberal obedience, without which your ramy would be a base rabble, and your navy nothing but rotten timbers."

This great idea has been borne in upon us through our experience in the European war. Our reasoning in regard to training and education is the same. We came out of the people; we went to the people for our personnel, and we want to do something in return for their sons while they are with us. We of the Medical Corps came out of the medical profession; it is our desire to keep in closest touch with the profession, working together, in the future as in the past, for the common good of our country. I ask you to consider, for a moment, the history of our Medical Corps in its relation to the American profession.

William Beaumont started experimental physiology in this country, Woodward photomicrography, Sternberg bacteriology, Billings advanced hospital construction, medical bibliography, medical statistics and the science of medical librarianship. While on duty in the Army during the Civil War, Weir Mitchell developed the science of the peripheral nerve lesions, which was the foundation of his work in neurology. Even your great anatomist, Joseph Leidy, did valuable postmortem work in our military hospitals during this period. After working under Welch at the Johns Hopkins, Walter Reed, with his associates in Cuba, demonstrated the transmission of yellow fever by mosquitos, and (with Vaughan and Shakespeare) of typhoid fever by flies. Gorgas then cleaned up Havana and Panama and made the Isthmus habitable. Russell introduced preventive vaccination against typhoid fever on a large scale. Hoff vaccinated the Porto Rican population and rid the island of smallpox and leprosy. In tropical medicine, I need only mention the work of Ashford on hookworm infection and tropical sprue, Craig on malarial fever and the parasitic amebas, Ashburn and Craig on filaria and dengue, Vedder on beriberi and amebic dysentery, Chamberlain on hookworm infection and beriberi, Gentry and Ferenbaugh on Malta fever and Whitmore on dysentery and yellow fever.

Since the close of the war there has been apparent a certain feeling of bitterness against the army. It is due in part to losses sustained, whether of relatives killed in battle or of income or of business advantages, to disappointments and disillusions; to the

fact that modern warfare is a drier, more business-like and less romantic enterprise than the wars of old; and to the natural distaste of average civilized humanity for a thing so disagreeable and troublesome as war. In general, it is a symptom of what Cushing calls "war weariness"; yet I myself believe that it is more common among those whose lot it was to chafe at the leash while doing their bit in the home territory than among those who served with us in France. Pacifists maintain that wars are avoidable things, by which they probably mean that civilized man, *i. e.*, man tamed and domesticated, would like to avoid them if he could. The European war resembled the great epidemics of the Middle Ages, which came suddenly down upon humanity, they knew not whence or where, with terrible death-dealing force. Epidemics and wars, as Crookshank points out, are not of simple, but of multiple or complex causation. The epidemic of influenza that followed this war was in reality far more destructive; yet who has succeeded in explaining, or even in exploring its causation? Crookshank believes that the remote causes of this epidemic are beyond human calculation. Wars, then, may some day perhaps be prevented, when there exist statesmen with genius and ability sufficient to prevent them. The business of armies, however, is to maintain peace in time of peace and to be ready for war whenever the defence of their country requires it. For the "never again" school there is only one answer, namely, that defenseless nations, like defenseless individuals, invite not only attack but also invasion of their territory. As Crookshank puts it, "Until war and pestilence are abolished, we must initiate schemes of defence." To guarantee the defence of a modern nation, there is only one means, namely, discipline and training. In the address I quoted at the beginning, Pericles counsels the Athenians who survived the first year of the Peloponnesian War to "pray for a safer fortune," but to be "no less venturously minded against the foe; not weighing the profit . . . but contemplating the power of Athens, in her constant activity: and thereby becoming enamored of her. And when she shall appear great to you, consider then that her glories were purchased by

valiant men, and by men who learned their duty; by men who were sensible of dishonor when they came to act; by such men as, though they failed in their attempt, yet would not be wanting to the city with their virtue, but made to it a most honorable contribution. . . Be zealous, therefore, to emulate them, and judging that happiness is freedom and freedom is valor, be forward to encounter the dangers of war."

It was in this spirit that the youth of our nation met the enemy, and you may read of what they did in the report rendered to the Secretary of War by their commander, General Pershing.

I ask that, as members of the medical profession, you will give to the Medical Department of the Army in time of peace the same loyal support and appreciation which you have rendered, and which we may count on you to render, in time of war.

A PRELIMINARY SKETCH OF THE HISTORY OF THE ROGER BACON CIPHER MANUSCRIPT.[1]

BY WILFRID M. VOYNICH

In 1912, during one of my periodic visits to the Continent of Europe in quest of rare old books and manuscripts, I came across a most remarkable collection of precious illuminated manuscripts. For many decades these volumes had lain buried in the chests in which I found them in an ancient castle in Southern Europe where the collection had apparently been stored in consequence of the disturbed political condition of Europe during the early part of the nineteenth century. Most of these manuscripts must formerly have belonged to the private libraries of various ruling houses of Italy, now extinct, since many of them were embellished with the arms of such personages as the dukes of Parma, Ferrara and Modena.

While examining the manuscripts, with a view to the acquisition of at least a part of the collection, my attention was especially drawn by one volume. It was such an ugly duckling compared with the other manuscripts, with their rich decorations in gold and colors, that my interest was aroused at once. I found that it was written entirely in cipher. Even a necessarily brief examination of the vellum upon which it was written, the calligraphy, the drawings and the pigments suggested to me as the date of its origin the latter part of the thirteenth century. The drawings indicated it to be an encyclopedic work on natural philosophy. I hastily considered the question of the possible authorship of

[1] Read April 20, 1921.

the work and the names of the only two thirteenth century scholars who could have written on such a variety of subjects occurred to me: first, Albertus Magnus, whom I at once eliminated from consideration because his ecclesiastic and political position was such that it could not have been necessary for him to conceal any of his writings in cipher, and, secondly, the Franciscan friar, Roger Bacon, an infinitely greater scholar, who had been persecuted on account of his writings and whose scientific discoveries had been misrepresented as black magic. Moreover, for many years he had been forbidden by his Order to write, and he himself referred in his works to the necessity of hiding his great secrets in cipher. Although I could not be certain of its authorship, the fact that this was a thirteenth century manuscript in cipher convinced me that it must be a work of exceptional importance, and to my knowledge the existence of a manuscript of such an early date written entirely in cipher was unknown, so I included it among the manuscripts which I purchased from this collection.[1]

The manuscript having passed into my possession, two problems presented themselves—the text must be unravelled and the history of the manuscript must be traced. I knew practically nothing about ciphers, and therefore I endeavored to awaken the interest of specialists in this volume, with the result that many distinguished American and European scholars have made attempts to decipher the manuscript, all without success except Prof. William Romaine Newbold, who, having discovered the key and reconstructed the system of the cipher, has begun to translate the manuscript. For my part I began to work on the less important but extremely fascinating problem of ferreting out the history of the work.

It was not until some time after the manuscript came into my hands that I read the document bearing the date 1665 (or 1666), which was attached to the front cover. Because of its late date I had regarded it as of no consequence, and therefore neglected it during my first examination of the manuscript. This docu-

[1] As I hope some day to be able to acquire the remaining manuscripts in the collection, I refrain from giving details about the locality of the castle.

ment, which is a letter from Joannes Marcus Marci to Athanasius Kircher making a gift of the manuscript to him, is of great significance, as can be seen from the following translation of it:

Reverend and Distinguished Sir; Father in Christ:

This book, bequeathed to me by an intimate friend, I destined for you, my very dear Athanasius, as soon as it came into my possession, for I was convinced it could be read by no one except yourself.

The former owner of this book once asked your opinion by letter, copying and sending you a portion of the book from which he believed you would be able to read the remainder, but he at that time refused to send the book itself. To its deciphering he devoted unflagging toil, as is apparent from attempts of his which I send you herewith, and he relinquished hope only with his life. But his toil was in vain, for such Sphinxes as these obey no one but their master, Kircher. Accept now this token, such as it is and long overdue though it be, of my affection for you, and burst through its bars, if there are any, with your wonted success.

Dr. Raphael, tutor in the Bohemian language to Ferdinand III, then King of Bohemia, told me the said book had belonged to the Emperor Rudolph and that he presented to the bearer who brought him the book 600 ducats. He believed the author was Roger Bacon, the Englishman. On this point I suspend judgment; it is your place to define for us what view we should take thereon, to whose favor and kindness I unreservedly commit myself and remain

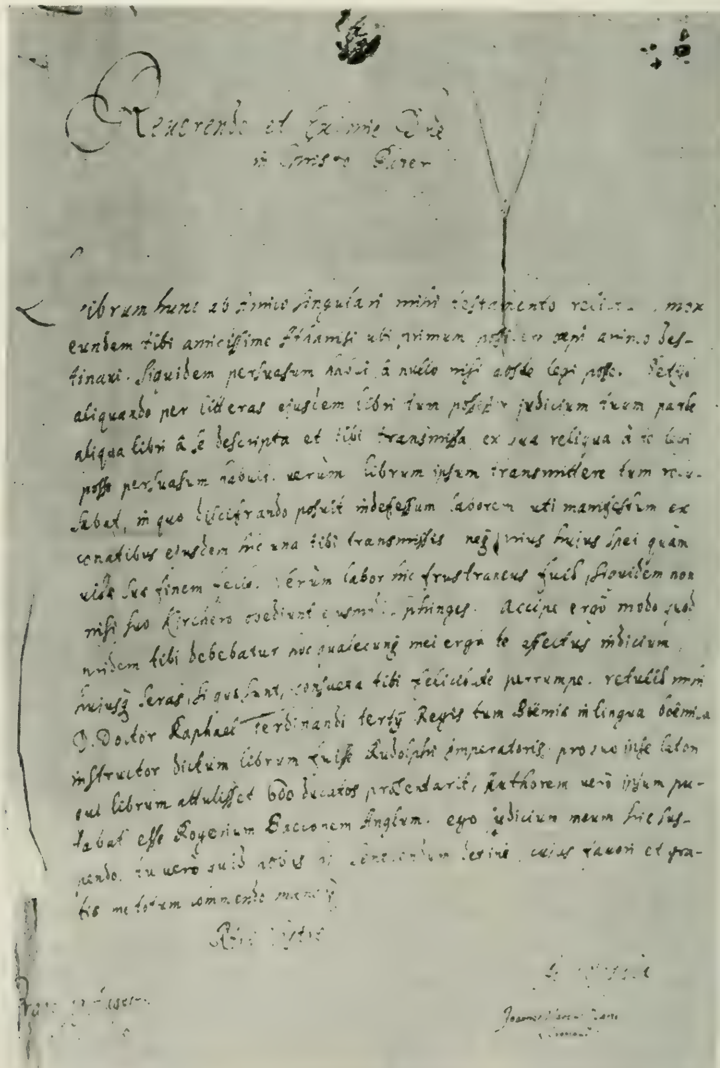
At the command of your Reverence,
Joannes Marcus Marci,
of Cronland.

Prague, 19th August, 1665 (or 1666). *

Who was Marcus Marci? Today he is nearly forgotten, but among his contemporaries he was held in great repute as physician, mathematician, physicist and orientalist, and he was rector of the University of Prague. That he was highly esteemed, not only on the Continent, we know from the fact that the London Royal Society, through Edward Brown, son of Sir Thomas Brown, desired in 1667 to invite him to become a corresponding member of the society. The invitation, however, came too late, for he had just died. Marci died April 10, 1667, at the age of seventy-two years. A few months before his death he entered the Jesuit house at Prague. Before joining the Order he distributed his books among his friends, and in August, 1665 (or 1666), he sent this cipher manuscript to Kircher. The letter, it will be observed, states that Marci had destined the manuscript for Kircher as soon as it came into his possession, since he was convinced, as he says, that such a Sphinx would obey no one but Kircher.

* For original letter see plate No. I.

Athanasius Kircher, the celebrated Jesuit scholar, was a man of immense erudition and only a little less credulity, and the author



Reverende et Eximie Domine in Christo Pater

Librum hunc ab amico singulari mihi testamento relictum, mox eundem tibi amicissime Athanasi ubi primum possideri coepi animo destinavi. Siquidem persuasum habui a nullo nisi abs te legi posse. Petiit aliquando per litteras eiusdem libri tum possessor judicium tuum parte aliqua libri a se descripta et tibi transmissa ex qua reliqua a te legi posse persuasum habuit. verum librum ipsum transmittere tum recusabat, in quo decifrando posuit indefessum laborem uti manifestum ex conatibus eiusdem hic una tibi transmissis neque prius huius spei quam vitae suae finem fecit. Verum labor hic frustraneus fuit, siquidem non nisi suo Kirchero obediunt eiusmodi sphinges. Accipe ergo modo quod iamdudum tibi debebatur hoc qualecunque mei erga te affectus indicium, huiusque seras, si quas habet, consueta tibi felicitate perrumpe. Retulit mihi quondam D. Doctor Raphael Ferdinandi tertij Regis tum Boemiae in lingua boemica instructor dictum librum fuisse Rudolphi imperatoris pro quo ipse latori qui librum attulisset 600 ducatos praesentarit, Authorem vero ipsum putabat esse Rogerium Bacconem Anglum. ego judicium meum hic suspendo, tu vero quid nobis hic sentiendum definias, cuius favori et gratiae me totum commendo maneoque

Plate 1.—Voynich.

of copious works on every conceivable subject, including several treatises on ciphers and hieroglyphics. Many of his works are studied even today. He was the friend of popes, emperors, kings and scientists, and Marci had studied under him in Rome. Among his many achievements was the foundation of the museum in Rome which bears his name, the Museum Kircherianum. He did not, however, include this cipher manuscript among his gifts to it, otherwise it would have been entered into the elaborate catalogue of the museum, which was first published at Amsterdam in 1678. Nor does he refer to this precious volume in any of the works published by him from the time he received it in 1665 (1666) until his death in 1680. But that Kircher took an interest in the manuscript is shown by Marci's letter, which reminds him that this is the same manuscript part of which had been copied and sent to him many years earlier by their mutual friend (unnamed), the then owner of the manuscript. Furthermore, the letter tells us that Kircher, upon receipt of these pages, wanted to see the original manuscript, but the owner refused to send it.

I have no direct evidence as to what Kircher did with the manuscript: and this is not important, because if its subsequent owners, from the time of the death of Kircher to the time when the manuscript was locked up in the chest in which it was found, had taken an interest in it some reference undoubtedly would be found in the literature of the enlightened eighteenth century. My own impression is that Kircher left the manuscript to someone at the Court of Parma, where he had patrons and friends, and it probably remained in the possession of a member of the Farnese family until, with other manuscripts, it was removed to the collection in which I found it.

The letter of Marci is also the clue to the earlier and much more important history of the manuscript. The first step to be considered in going backward was to ascertain, if possible, the identity of the intimate friend of Marci, who, after toiling over this manuscript for many years, had left it to him in his will. I hope that researches into the Bohemian State Archives will lead to the discovery of his name. The period of his ownership of the manuscript has, however, been approximately established.

Marci closes his letter by reminding Kircher that a certain Dr. Raphael once told him that this manuscript had been presented to Emperor Rudolph, that the Emperor had rewarded the messenger with six hundred imperial golden ducats (an enormous sum for that period) and that the manuscript had been attributed to Roger Bacon, the Englishman. Marci hardly facilitated my investigations by omitting to mention the surname of Dr. Raphael, but his statement that Dr. Raphael formerly taught the Bohemian language to Ferdinand III was of great assistance in identifying him, and so makes up for this omission.

Was the assertion that the manuscript had been presented to Emperor Rudolph based on tradition or was Dr. Raphael a contemporary of his and, as such, in a position to make this statement? From his biography it is clear that he was closely connected with the Court of Rudolph.

According to the Bohemian biographical dictionaries and information supplied by the director of the Bohemian State Archives, Dr. Raphael, a lawyer and minor poet, known as Missowsky, after his Polish mother, was born in 1580. He began his career as secretary to Cardinal Melchior Klesl, at the Court of Rudolph. Later, when he was at the Court of Ferdinand II, he was tutor in the Bohemian language to the Emperor's children, one of whom was afterward the Ferdinand III mentioned in Marci's letter. Under Ferdinand III he became attorney-general of Bohemia, and he died in 1644.

As Marci's letter indicates that he had spoken with Dr. Raphael about this manuscript, it is obvious that he must have done so by 1644, the year of Dr. Raphael's death, and this would seem to indicate that in all probability the manuscript was in Marci's possession as early as this. Since the manuscript was bequeathed to Marci, it furthermore suggests that the person who made the bequest did not live after 1644. It is known (as is shown later on) that a still earlier owner of the manuscript died in 1622, so investigation as to the identity of this temporarily anonymous owner is narrowed down to a period of about twenty-two years. Of course, there is a possibility that during this period the manuscript passed through the hands of more than one owner.

When I brought this manuscript to America the margins of the first page had the appearance of being blank, but an accident to

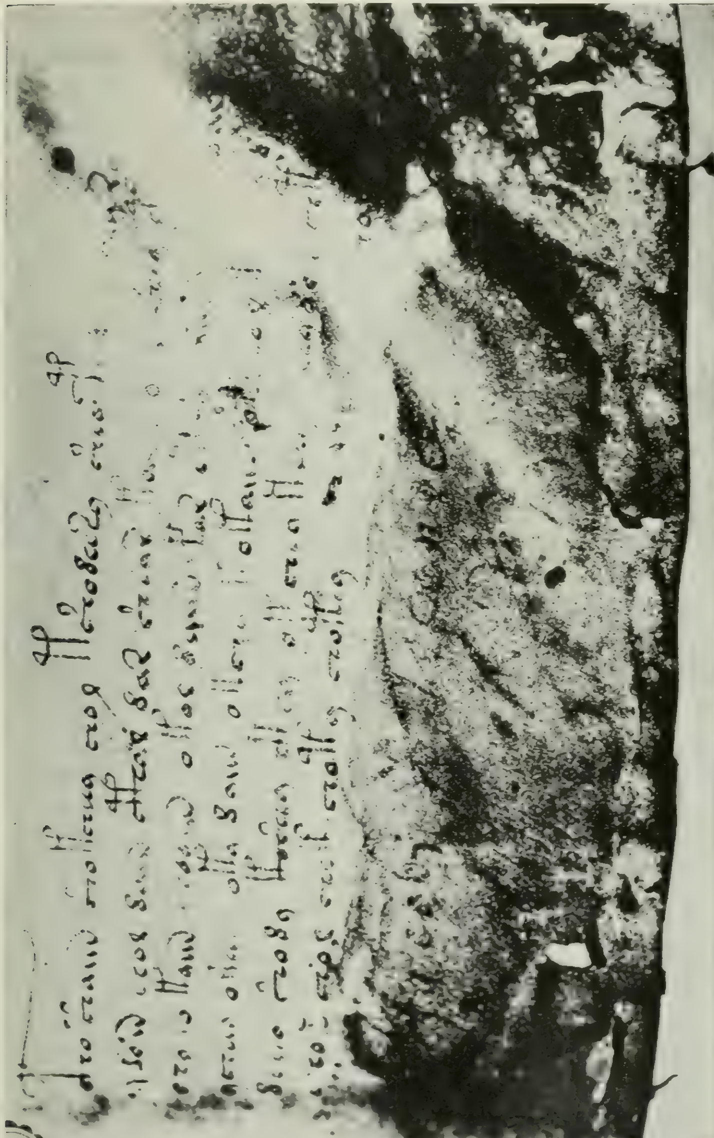


PLATE 2.—Voynich.

a photostatic reproduction of this page revealed the fact that an underexposure of the plate brings out a faded autograph in the lower margin. Chemicals were applied to the margins and the autograph, Jacobus de Tepenecz, became visible, with some illegible figures below it.

Bohemian biographical dictionaries yielded the information that Jacobus de Tepenecz was a Bohemian scientist, ennobled by Emperor Rudolph in 1608. He had the right only from that time to sign himself as "de Tepenecz." Earlier he was known as Horcicky, or, in the Latinized form, Sinapius.[1] At one time he was director of the alchemical laboratory of the Emperor, and from 1601 he was director of the Imperial Botanical Garden. He invented a prototype of *eau de cologne*, calling it *aqua sinapis*, which was used as a universal remedy. The *aqua sinapis* brought him such wealth that he was able to and did lend the Emperor enormous sums of money, in pledge for which he received the whole district of Melnick. He was on intimate terms with Emperor Rudolph, and is credited with having cured him of a very dangerous illness. He died in 1622, leaving much property to the Jesuits at Prague.

The signature of Tepenecz could not have been placed in the manuscript earlier than 1608, because it was in that year that Horcicky was granted the name of Tepenecz by the Emperor. How he obtained the manuscript remains unknown, but there are two possibilities especially worth considering. Since Dr. Raphael said the manuscript was once in the possession of Emperor Rudolph, either the Emperor, who shared Tepenecz's intense interest in botany and the occult sciences, presented the manuscript to him, or, what seems to me much more likely, lent it to him for working purposes. During the year following the abdication of Emperor Rudolph, which took place in 1611, many treasures were looted from his museum and then Tepenecz probably felt justified in retaining the manuscript.

Before continuing the history of this manuscript a few facts

[1] The director of the Bohemian State Archives has very kindly supplied me with a copy of Emperor Rudolph's patent of nobility to Horcicky.

regarding Emperor Rudolph and his remarkable interests should be recalled. From the time of his election as Emperor of the Holy Roman Empire, in 1576, his passion for art and science, especially alchemy and metallurgy, steadily grew. He formed the largest and most important museum of his time. Soon after his death, its objects, made of precious stones and metals, alone were valued by Boulenger at seventeen million gulden. Under the direction of the celebrated antiquary, Jacobo di Strada, afterward von Rossberg, he gathered together over seven hundred famous pictures for his gallery. He had an observatory built for Tycho Brahe and Kepler and a botanical garden was founded by him which was under the supervision of such celebrities as Charles de l'Ecluse and Sinapius. Numberless scientists were invited to his famous laboratory—alchemists, chemists, astronomers, metallurgists, and adventurers of all descriptions and political spies from every country found it profitable, though dangerous, to join them. The scientists at his court, however, led a very precarious existence. A successful discovery or experiment sometimes brought wealth and titles to its author, or court intrigues, suspicion of fraud or the irritable moods of the Emperor resulted in his imprisonment, expulsion or execution. As the years passed the Emperor came more and more to neglect the affairs of state, and, as his inherited melancholy developed, he spent most of his time in his alchemical laboratory or in his museum, surrounded only by a few temporary favorites.

The testimony of Dr. Raphael, a contemporary courtier, that the manuscript was once in the possession of Emperor Rudolph is fairly conclusive. The autograph of Jacobus de Tepenecz, who was the Emperor's intimate friend and lived at his palace, confirms the fact that this manuscript had found its way to his court.

Who could have brought this cipher manuscript to him? Who could have convinced the Emperor of its tremendous importance and claim authoritatively that it was the secret work of Roger Bacon, the alchemist of alchemists? I was compelled to peruse the biographies of several hundred people who had visited or

lived at his court and their lives passed through a veritable sieve of investigation without substantial residue, except one which proved to be a real nugget. Shakespeare says of him that he had volumes which he prized more than his dukedom, and calls him Prospero, but in everyday life he was known as Dr. John Dee,[1] a very romantic and mysterious personality. Volumes have been written about him, representing him principally as a great mathematician, astrologer and necromancer. I hope to be able to give a new significance to some of his activities.

Born in 1527, Dee lived under the reigns of Henry VIII, Edward VI, Queen Mary, Queen Elizabeth and James I, and he died in 1608. He was an adept in astrology and the occult sciences, and we know from his works that he had studied ciphers, a knowledge of which he considered indispensable to the student and statesman. In his early youth he was already the author of mathematical and astronomical works, and at the age of twenty-three he was the first public lecturer on Euclid. These lectures, which were given in Paris at Rheims College, attracted students, professors and even princes from various parts of Europe. He was constantly connected with necromancy and implicated in political plots, and to the end of his life he was under a cloud of suspicion.

Dee had no creative power nor a constructive mind and has written little that is original or of intrinsic importance, but his studies and activities were of great value. From his youth he had access to many manuscripts of the works of Roger Bacon, even to some which have not come down to us. He was absorbed in the study of these manuscripts, and his repeated efforts to promote a revival of interest in Bacon met with undoubted success. In his efforts to make Bacon's philosophy known to his contemporaries he aroused the interest of several prominent men. For example, at the Court of Elizabeth he met Francis Bacon, whose father was one of Dee's friends, and it is recorded in his *Diary* (August 11, 1582) that Francis Bacon, who at that

[1] D'Israeli (Is.): *Amenities of Literature*, London, 1841. See article on John Dee.

time was only twenty-one, called on him at Mortlake. Knowing Dee's enthusiasm for Roger Bacon, it is not too much to suggest that he introduced the two Bacons to each other. This at any rate provides an explanation of the origin of the remarkable influence of Roger Bacon's ideas, which can be traced in the writings of Francis Bacon. This influence has been noted by many modern writers, but unfortunately it has yet to receive adequate discussion. The visit to Dee's library, in August, 1582, is particularly significant when we remember the testimony of Francis Bacon that he began to work on his *Instauration of Philosophy* in the following year, 1583, as was noticed by an American student, Miss Mary Esther Trueblood, of Mt. Holyoke College, in an article written by her, "John Dee and His 'Fruitful Preface.'"[1] This bringing together of the two great Bacons surely entitles Dee to a niche in the history of human knowledge.

In spite of Dee's zeal in reviving an interest in Roger Bacon his attitude was very strange. It was marked at times by a secretiveness which suggests he was afraid to associate his name with that of the great heretic lest it would add to the notoriety and suspicions under which he was already suffering. Sometimes in dealing with Bacon he effaces himself entirely and sometimes he suppresses the name of Bacon. A few facts will illustrate this: In his *Diary* he describes in some detail his two visits to Louvain (1547 and 1548) for the purpose of ordering some mathematical instruments and studying under Gogava, Frisius and Mercator, but he does not mention that as an obvious result of his visits Gogava published in 1548 two mathematical treatises attributed to Bacon, *De Sectione Conica*[2] and *De Speculo Comburenti*.[3] In 1557 Dee wrote a work on Bacon, *Speculum Unitatis sive Apologia pro Fratre Bachone*, but he never ventured to publish it, and unfortunately the manuscript is lost. In 1570, in the re-

[1] *Popular Science Monthly*, Lancaster, Pa., 1910, lxxvii, 236–241.

[2] In a humanistic version by Ant. Gogava Graviensis in *Cl. Ptolomaei Pelusiensis Mathematici Operis Quadripartiti in Latinum Sermonem traductio . . . Item de sectione conica, orthogona, quae parabola dicitur; deque speculo Vstorio Libelli duo hactenus desiderati, Louvain, 1548.*

[3] *Antiqui scriptoris libellus de speculo comburenti, concavitatis parabolæ* (Revised version by Ant. Gogava, Louvain, 1548.)

markable preface to the first English edition of Euclid, he speaks at length of the genius of Roger Bacon and his place in the history of science, but he avoids mentioning him except under the letters "R. B." At an uncertain date Dee copiously annotated Bacon's manuscript on the *Miracles and Art of Nature*,[4] which, however, was not published until 1618 in Hamburg, ten years after his death, and in an English translation only in 1659. In this connection I should like to add that undoubtedly it will repay students of English literature to investigate the circumstances under which appeared the manuscript of the famous chap-book, *Fryer Bacon and Fryer Bungay*, Greene's play based on this story and the three Bacon treatises[5] published in England during the nineties of the sixteenth century.

But sometimes Dee was talkative, especially when he was on the Continent. Swatek,[6] the Bohemian historian, records and the American chemist, Henry Carrington Bolton,[7] repeats after him that during his various visits to Prague (1584-1588), Dee talked with Emperor Rudolph for hours about the secrets and inventions of Roger Bacon. Apparently his conversations on this theme were not confined to the Emperor's presence but were heard elsewhere, for about this time the name of Roger Bacon became a token of wisdom and learning in the intellectual circles of Prague. An interesting instance of this is found in the fact that a contemporary, the great Rabbi Bezolel Loew, of Prague, famous for his cabalistic learning, was called "Der kleine Bacon."

In following the career of Dee the impression grows that Bacon's influence upon him was overwhelming. While he was still a student at Cambridge, he began even to imitate Bacon's mode

[4] *Epistola Fratris Rogerii Baconis de Secretis Operibus Artis et Naturæ et de Nullitate Magiæ. Opera Iohannis Dee Londinensis e pluribus exemploribus castigata olim et alius sensum integrum restituta . . . cum notis quibusdam partim ipsius Iohannis Dee partim edentis*, Hamburg, 1618.

[5] (*a*) Bacon, R.: *Libellus de retardantis Senectutis Accidentibus et de Sensibus Conservandis*, Oxford, 1590.

(*b*) Bacon, R.: *Epistola fratris Rogerii Baconis de Secretis Operibus naturæ et de nullitate magiæ*, Oxford, 1594.

(*c*) Bacon, R.: *Mirror of Alchimy. Also a most excellent Discourse of the admirable Force and Efficacies of Art and Nature*, London, 1597.

[6] Swatek, Josef: *Obrazy z kulturnich dejin ceskych*, Prague, 1891.

[7] Bolton, Henry Carrington: *The Follies of Science*, Milwaukee, 1904.

of life by working eighteen hours a day and sleeping only four. Much later, in 1582, in the Memorial[8] on the reformation of the calendar, presented to Queen Elizabeth, which was based on Roger Bacon's work on the subject, Dee asserted that he was a descendant of Bacon, for, he informs Her Majesty, Roger Bacon was really David Dee, of Radik, and had only assumed the name of Bacon on joining the Franciscan Order.

A careful study of Dee's *Diary* and his activities suggests that while he was at Cambridge he was already the owner of an enormous collection of Bacon manuscripts and works studied by Bacon and quoted in his writings. In a catalogue of Dee's library, prepared in 1583, just before a mob at Mortlake destroyed many of his books, believing him to be a necromancer, Dee enumerates thirty-seven works of Bacon bound in twenty-six volumes, and numerous other manuscripts, many of them undoubtedly from Bacon's library. This is a very large collection when we consider that Prof. Little, the latest and best bibliographer of Bacon manuscripts, has succeeded in locating only 107 items written before the time of Dee, which number includes even fragments and single leaves.

Some of the Bacon manuscripts now on the Continent—those at Prague, Vienna, Bruges, Leyden, Wolfenbuttel and Erfurt—were probably gifts from Dee, for he visited all these places and made friends there. Originally Dee must have had even more Bacon manuscripts, as the following information would indicate. In 1634 the Bodleian Library accepted a gift of 238 manuscripts from the celebrated physician and Rosicrucian, Sir Kenelm Digby. Among these were at least twelve Bacon manuscripts, as we learn from Prof. Little, who enumerates in his catalogue twelve Bacon manuscripts containing the autograph of Digby. Digby could not have been acquainted with Dee, since he was born only in 1603, five years before Dee's death. Nevertheless the Digby Bacon manuscripts once must have belonged to Dee. In 1630,

[8] *An advise or discourse about the Reformation of the vulgar Julian yeare, written by her Majesties commandement and the Lords of the Privy Council*, 1582. Unpublished. The original manuscript is in Corpus Christi College, Oxford, among the Bryan Twyne manuscripts.

according to one authority, Digby bought, or, according to other authorities, received as a gift the entire library of Thomas Allen, of Oxford, his friend and teacher. Thomas Allen was an intimate friend and collaborator of Dee, with whom he had spent some time at the house of Henry Percy, ninth Earl of Northumberland, the so-called Wizard Earl. Here they worked together on Bacon and alchemy. Allen and Dee also intrigued as political agents of the Earl of Leicester. They are both referred to by the author of *Leicester's Commonwealth*, London, 1641, who says, "The Earl kept about him Dee and Allen, two atheists, for figuring and conjuring." Fuller says of Allen that he had succeeded to the skill and scandal of Fryer Bacon. Allen was fifteen years younger than Dee and therefore Allen's Bacon manuscripts could not have been obtained by him at the same time as Dee came into possession of his; but in view of the close relations which existed between them, it is quite probable that Dee shared his manuscripts with Allen.

From these facts relating to Dee it is reasonable to conclude that owing to his efforts many of Roger Bacon's works were preserved and are known to us today, and that he was the chief promoter of interest in the works of Bacon during the sixteenth and seventeenth centuries. It is, I think, also reasonable to deduce from these facts that in the collection of Bacon manuscripts, which unquestionably came into his possession as early as 1547, he found the cipher manuscript.[9] The sequence of events which suggest themselves is that, having failed to decode it, he carried the manuscript to Prague, where he parted with it as a "present" to Emperor Rudolph. He can only have presented it to the Emperor between 1584 and 1588, during which years he made several visits to Prague. He may have made this presentation either in his own name or in the name of Queen Elizabeth, on whose behalf he acted as a secret political agent at the Court of Rudolph.

[9] Perhaps it is to this cipher manuscript that Dr. Arthur Dee (John Dee's son) refers in the following: Sir Thomas Brown relates in 1675 to Ashmole, "That Dr. Arthur Dee (speaking about his father's life in Prague) told about . . . book containing nothing but hieroglyphicks, which book his father bestowed much time upon, but I could not hear that he could make it out," Fell-Smith (Charlotte), *John Dee*, pp. 311 312.

Most of the Bacon manuscripts definitely known to us as having been in Dee's possession passed comparatively quickly into collections which have now become public. It is also worthy of notice that very few of the known manuscripts of the works of Roger Bacon were of the thirteenth century. Many of them were written during the fourteenth and fifteenth centuries, and often with copious annotations, which are evidence of the existence of groups of students who during this time were working so that the teachings of Roger Bacon should be transmitted to their contemporaries.

How Bacon's discoveries and ideas have filtered into the scientific literature of the fifteenth century can be shown by mentioning one or two works in point. For example, the *Imago Mundi*, 1485, of Petrus de Aliaco, made famous by the praise of Columbus, is based on Bacon's geographical work. Paulus de Middelburgo borrowed much from Bacon in connection with his treatise on the reformation of the calendar, *Paulina de recta Pascha celebratione*, Fossombrona, 1513. No one, however, dared to acknowledge Bacon as an authority, since he had been condemned by the Church, and it was dangerous even to mention his name. Further researches in the scientific literature of the fourteenth and fifteenth centuries and the translation of my cipher manuscript, which is now made possible by the remarkable discovery of Prof. Newbold, will undoubtedly show that Bacon's influence was much wider and more penetrating than is conceded today.

There remains the task of tracing the place or person from whom Dee obtained his Bacon manuscripts. The information already gathered points very strongly in the direction of the Northumberland family. The patronage of both branches of that family, the Dudleys and the Percys, is apparent throughout the whole of Dee's life. As early as 1553, when Dee was only twenty-six years old, but already the owner of some Bacon manuscripts, he was so closely associated with the mother of the Earl of Leicester, Lady Jane, Duchess of Northumberland, that at her request he wrote two works: *The True Cause and Account of Floods and Ebbs* and *The Philosophical and Poetical Original*

Occasions of Configurations and Names of the Heavenly Asterismes (unpublished). It is known that during the period of the dissolution of the monasteries in England, which began in 1538, Lady Jane's husband, John Dudley, Duke of Northumberland, amassed a large fortune by the unscrupulous pillaging of religious houses, chantries and churches. In view of this fact, and Dee's intimate relations with that family, it is probable that Dee profited by the Duke of Northumberland's spoils, and that his collection of Bacon manuscripts originated in this way. Further researches into the history of John Dudley, Duke of Northumberland, and the dissolution of monasteries in England may lead to important discoveries. It may help to locate the repository or repositories of Bacon's manuscripts; it may also disclose the names and works of his immediate pupils and those who in the following two centuries studied him and copied and annotated his works.

To summarize, then, the history of this manuscript so far as at present can be ascertained or reasonably conjectured, we must conclude that it rested in some monastery in England, where Roger Bacon's manuscripts remained until the dissolution of the religious houses in the sixteenth century. At that time, together with other treasures from these disbanded libraries, it probably passed into the hands of one of the receivers of this spoil, the Duke of Northumberland. It was very likely one of the manuscripts probably found in this family's possession by John Dee, who certainly early in his career obtained a collection of Bacon manuscripts. During one of his visits to Prague, Dee undoubtedly presented it to Emperor Rudolph II, from whose possession it passed into the hands of Jacobus de Tepenecz not earlier than 1608. The manuscript then passed into the possession of a person whose name is at present unknown but who is known to have bequeathed it to Marcus Marci. It was given by Marci, in 1665 (or 1666), to Athanasius Kircher. Its subsequent history becomes again conjectural, and we may suppose that it was presented by Kircher to a patron in one of the ruling houses of Italy, after which it remained buried until it was discovered by me in 1912.

THE VOYNICH ROGER BACON MANUSCRIPT

THE MARY SCOTT NEWBOLD LECTURE
LECTURE V[1]

By WILLIAM ROMAINE NEWBOLD, PH.D.; LL.D.

ADAM SEYBERT PROFESSOR OF INTELLECTUAL AND MORAL PHILOSOPHY IN THE UNIVERSITY OF PENNSYLVANIA.

THROUGHOUT the dark and turbulent stream of human history there runs a series, often obscured or interrupted but always recurring, of wholly beneficent discoveries, marking the successive steps in man's acquisition of control over the powers of nature. Some primitive creature first grasped a stone as a weapon, and thus made man a tool-using animal; another wielded a stick, discovering the principle of the lever; another chipped his stone, and introduced the cutting edge; another learned to smelt copper, and the age of metals dawned. Of these benefactors of the human race, few even of later times are known by name, and they receive but scanty honor. Not many statues are erected to their memories, and seldom does anyone think of them with gratitude.

Still more seldom does anyone think of those men of genius, and there must have been many of them, who lived and labored for the advancement of knowledge, yet died in the bitter consciousness of failure. Some were intellectually unequal to the task they had set themselves; some saw their efforts frustrated by untoward circumstances; some succeeded in their efforts, but only to find themselves overwhelmed by incredulity, obloquy, even persecution. One such genius, whom his contemporaries

[1] Read April 20, 1921.

could neither understand nor appreciate, is soon, I hope, to be accorded the honor which is his due.

Of all inventions, few if any have contributed more to the increase of knowledge than those of the microscope and the telescope. The telescope has extended the range of vision far out into the depths of space; the microscope has revealed the existence of the unimagined realm of the infinitely little, and often exposes to view the secret mechanism by which the processes of nature are accomplished. That both of these indispensable instruments were known to and probably discovered by Roger Bacon, and that by their means he made discoveries of the utmost importance, the Voynich manuscript puts beyond the range of reasonable doubt.

Born near the beginning of the thirteenth century, Roger Bacon lived almost to its end. He was a contemporary of that eccentric genius Emperor Frederick II; of Henry III, King of England, in whose unworthy cause Bacon's brothers fought and were impoverished; of his son, Edward III, "the English Justinian," who laid the foundations of the present system of English law and crystallized into being the English Parliament, ancestress of all the democratic governments of the present day. Bacon's life was passed at Oxford and Paris, the centers of the intellectual life of the age, and thus he became personally acquainted with its leaders—among them, to mention a few out of many, with Robert Grosseteste, scholar, statesman, Bishop of Lincoln; with Saint Bonaventura, the devout and mystical theologian, head of the Franciscan Order of which Bacon was a member; and in particular with Albertus Magnus, and probably with Thomas Aquinas. These two, the most renowned of the scholastic philosophers, were even then engaged in assembling the whole of knowledge, especially as recorded in the encyclopedic works of Aristotle, in order to show its harmony with the doctrines of the Catholic Church, and the system of philosophy which they built up is to this day, I believe, taught in every Catholic institution of learning.

In that age Bacon lived, but he was not of it. He belonged rather to our own time. The knowledge amassed with such toil

by his contemporaries he contemptuously casts aside as little better than rubbish;[1] it is founded, he holds, in the main upon reverence for authority, and reverence for authority but too often leads to little more than repetition of ancient errors. There is but one ultimate test of knowledge, experience, and but one way of organizing such knowledge into a science, namely, by showing its conformity to the laws of mathematics.[2]

Thus Bacon lays down with an assurance which, in view of the embryonic condition of the physical sciences known to him, one can but compare to the intuition of a supreme genius, the fundamental principle of mathematical physics. Only less amazing are his bold applications of common-sense principles in the fields of textual criticism and of education, especially as regards the necessity of knowing the original languages of works usually read in translations, his appreciation of the need of endowing research work, his forecasts of the development of medicine in the direction of hygiene and preventive medicine, of the applications of chemistry to physiology, medicine, agriculture and industry, and his visions of the contributions to human comfort which applied science ultimately was to make by producing a multitude of useful inventions.

Many of his theories, supposed facts and forecasts were of course mistaken—how could they not be, in view of the poverty of the intellectual nourishment with which he had to feed his genius? The universities of Oxford and Paris were almost wholly given over to theology and the Aristotelian science and philosophy. Bacon mastered all that was then known of Aristotle, but Aristotle's method, for reasons which I shall presently explain, was of little assistance to him. At Oxford, Grosseteste, himself a scientific genius of no mean order, implanted in Bacon's mind many of the principles which were later regarded as original with his pupil,

[1] *Opus Minus*, 325–30; *Opus Tertium*, 30–31; *Opus Maius*, i, 2–4. *Fr. Rogeri Bacon, Opera quædam hactenus Inedita.* Ed. J. S. Brewer (Rolls's Series), 1859, contains the only edition of the *Opus Tertium*, *Opus Minus* and *Compendium Studii Philosophiæ*, and the only accessible edition of the *de Secretis Operibus Artis et Naturæ et de Nullitate Magiæ*. The only available edition of the *Opus Maius* is that of J. S. Brewer, Oxford, 1897, vols. i, ii; Supplementary Volume (iii), London, 1900.

[2] *Opus Maius*, i, 97 sqq.

and also first introduced him to the languages and to the study of the non-Aristotelian science. Bacon learned Greek, and diligently sought out the existing remains of Greek and Roman science, and of the Arabic science which had been inspired by it and had recently been translated into Latin. Thus he learned the Greek arithmetic, the Hindu-Arabic system of notation and calculation, the Greek and Arabic optics, astronomy, astrology, alchemy and medicine. He acquired considerable knowledge of Hebrew and Aramaic and probably a little of Arabic. He even learned something of that strange Gnostic philosophy, the Kabbalah, which, after being handed down among the Jews by secret channels for a thousand years, was in Bacon's own lifetime being compiled into the *Zohar*.

In all these sources he found theories aplenty, but comparatively little of that empirical knowledge for which his soul hungered. So he sought it elsewhere. As Aristotle had done before him, he inquired among the artisans, farmers, old-wives and other such simple folk. Each of them, however ignorant, knew something which the most learned scholars did not know. "From them," says Bacon, "I learned more and beyond all comparison more important things than from all my learned doctors."[3]

Still unsatisfied, he ventured yet further from the beaten track, into fields in which no son of the Church could roam save at his peril. He studied the magic properties of herbs, the virtues of charms and incantations and the like, seeking out in all the forbidden books the secrets of Greek and Roman, Jewish and Arabic, magic and necromancy.

When writing to Pope Clement, in 1267, Bacon drew a sketch of the ideal scientist, ostensibly the portrait of an unnamed friend. The context indicates that Peter of Maharncuria was the friend in question; but one can scarcely doubt that, as he was drawing it for the Pope to contemplate and to admire, he must have hoped that the Holy Father would realize there was another man besides Peter who might have sat for that portrait. And as every line

[3] *Opus Maius*, i, 23.

of the sketch can be shown to portray faithfully Bacon's own features, I need make no apology for quoting it in full. Bacon has been speaking of optics, and proceeds:[4]

"I know of no man save one who deserves credit for his work in this science. In lectures and wordy battles he has no interest, but pursues his scientific work and in it finds contentment. So it is that all which other men are blindly trying to see, like bats in the twilight blinded by the setting sun, he contemplates in the full glare of day, because he is a master of experiment. Therefore by experiment he acquires knowledge of the products of Nature, of the things studied by medicine and alchemy, of all things indeed whether in heaven or on earth. He is in fact ashamed that any layman or old crone or soldier or rustic fresh from the country should know anything which he does not himself know. Hence he has peered into all the processes of smelters, of goldsmiths, of silversmiths, and of other workers in metals and minerals; he knows everything pertaining to war, weapons and hunting; he has examined everything pertaining to agriculture, surveying and other occupations of the countryman; he has even taken into consideration the experiments of witches and their fortune-telling and charms and those of magicians in general, likewise the tricks and illusions of legerdemain—so that nothing worth knowing might remain unknown to him and that he might know what to condemn as due to sorcery or magic. Hence without his aid philosophy cannot be perfected, nor can it be pursued with any good or trustworthy results. Moreover, as he is beyond price, so also does he put no price upon himself. If he wished to meet kings or princes on terms of equality he would easily find one to honor and enrich him; indeed, if he were willing to exhibit at the University of Paris what he has learned by his scientific work the whole world would, follow him. But because either of these courses would interfere with the splendid experiments which give him the highest pleasure, he disregards all honor and riches, the more willingly because he can acquire wealth by his science whensoever he will."

In the Gasquet *Fragment* Bacon[5] gives a vivid picture of the difficulties with which a scientific investigator of the thirteenth century had to contend. After speaking of the dishonesty and untrustworthiness of most professional copyists, he proceeds:

"And inasmuch as besides copyists other persons are required who will keep watch on their dishonesty and negligence, who will not only

[4] *Opus Tertium*, pp. 46–47.

[5] *An Unpublished Fragment of a Work by Roger Bacon*, discovered and published by Cardinal Gasquet, *English Historical Review*, July, 1897, p. 501.

correct the copies but are also expert in computations, calculations and languages (for without these three nothing of moment can be accomplished, as will be made manifest from the books which I am sending your Glory), there is more labor in scientific work than any one unacquainted therewith could imagine. Furthermore, without astronomical, geometrical and optical instruments, and those of many other sciences, nothing can be accomplished, for through these we acquire knowledge of many celestial objects and from them the causes of the things beneath them. But effects cannot be known without their causes, therefore without such instruments nothing of great moment can be known. One ought then to have them, and yet few of them have been manufactured among the Latin-using peoples. Also a plentiful supply of books is needed relating to all the sciences, historical records (*actorum*) as well as the works of learned men of old, and they are not to be found either in my possession or in that of any one else; one has to collect them from the libraries of scientific men in various countries. Furthermore, since authors contradict one another on many points and have made many assertions on merely hearsay evidence, it is necessary to ascertain the truth by experience of actual facts, as I prove in my treatise on the experimental sciences. For this reason I have very frequently sent beyond the sea and to various other countries and to the regular fairs that I might see the objects of Nature themselves with my eyes and test the reality of the created thing by sight, touch, smell and sometimes by hearing, and by the certitude of experience, in cases in which the truth was not made self-evident to me by books, just as Aristotle sent many thousand men through various countries in order to learn the facts about things."

The general nature and range of Bacon's scientific work may be gathered from various passages in the books addressed to Pope Clement IV in 1267. He has been a hard student ever since he learned his letters, a period of about forty years, except that two of those years were devoted to the recovery of lost health. About twenty years were devoted especially to the study of science, and ten of the twenty to optics. During these twenty years he had spent on "secret" books, experiments, languages, instruments, astronomical tables, in forming friendships with scientists, in teaching his assistants the languages and the use of figures, tables, instruments and the like, more than two thousand pounds, which, even if taken only as Parisian pounds, would be equivalent in

purchasing power to about fifty thousand dollars of our money, an average of two thousand five hundred dollars a year.[6]

The precise date of Bacon's entrance into the Franciscan Order is not known, but comparison of his various allusions to his past life indicates 1256 or 1257 as the most probable years. During the ten years preceding 1267 ill-health had made him an exile from the public lectures and debates of the University of Paris, in which he had formerly won no little reputation, and that same lack of health, combined with lack of money, isolation from his friends and collaborators, and the insistence of his superiors that he devote himself to other occupations, had compelled him not only to forego the composition of scientific works but also to leave incomplete and unused the "many useful and grand wonders of science" which he had brought together at great cost of time and money, partly from books and partly as the results of his own experimental work.[7]

It is obvious that the greater part of the twenty years of work must have preceded, and the ten years of comparative idleness have followed, Bacon's entrance into the Order; the remaining ten years of the forty that have elapsed since his childhood were, presumably, those of his early education.

The motives which prompted Bacon, when forty years or more of age, to enter the Franciscan Order are entirely unknown and I shall not venture to speculate upon their character. Whatever they were the step must have proved highly detrimental to his scientific work. Undoubtedly his interest and belief in alchemy, astrology and magic must have brought him under grave suspicion

[6] *Opus Tertium*, pp. 7, 38, 59, 65; Gasquet *Fragment*, pp. 500, 507. Purchasing power calculated from the data given by Sir J. H. Ramsay, *Dawn of the Constitution*, 1908, pp. 300 sqq.

[7] *Opus Tertium*, p. 7: . . . recolens me iam a decem annis exulantem quantum ad famam studii quam retroactis temporibus obtinui . . . Gasquet *Fragment*, p. 500: Insuper quia iam a decem annis propter languores multos et infirmitates varias occupationibus exterioribus studii non vacavi . . . Multa vero alia fuerunt impedimenta componendi, scilicet langor continuus, defectus expensarum, adiutorum inopia. Nullus enim per se sufficit in rebus eximiis. Affuit enim instantia prelatorum meorum cotidiana ut aliis occupationibus obedirem et ideo non potui aggredi que volebam: immo aggregatis impedimentis incepi desperare, et multa utilia et magnifica sapientie spectacula, que variis expensis ac scripturis et laboribus multis et tempore longo collegeram, neglexi antequam primum vestre dominationis recepi mandatum.

of heresy, and his superiors could not have been disposed to encourage him in them. It is not probable that they absolutely forbade them, but they refused him the authorization without which no Franciscan brother could write for publication, and they kept him, as above related, so busily occupied with uncongenial tasks, among which begging food for the support of the monastery at Paris was probably not the least uncongenial, that he had little time or energy for anything else. Bacon's frequent allusions make it abundantly evident how these restrictions galled his proud spirit, and one can imagine how eagerly he would have looked for some way of deliverance.

In the year 1265 a ray of hope dawned upon him. Guy de Foulques, or Guido Fulcodi, who had been Archbishop of Narbonne before his elevation to the Cardinalate, was in that year elected to the chair of St. Peter and assumed the title Clement IV. He was a man of superior ability, of pure life, high ideals and determined will, had had a distinguished career as a soldier and statesman before his entrance into the Church, and had known of Bacon and displayed interest in his work before his election as Pope. Elated at the possibility of finding so powerful a protector, Bacon wrote him a letter, sent it by a friend, Sir William Bonecor, and authorized him to explain more at length to the Pope his purpose in writing it. That letter has been lost, but from the Pope's reply[8] one may infer that in it Bacon spoke of his work and also offered the Pope certain remedies in connection with a crisis of some sort. The reply was written in June of 1266; the Pope asks Bacon to send the works which he understands Bacon had written and also to inform him as secretly as possible what the remedies in question were.

The despised and oppressed scholar was transported with joy. After only six months of preparation he wrote in one short year, notwithstanding the all-but-insuperable difficulties interposed by his poverty and by the opposition of his superiors, the three bulky works upon which his fame has hitherto mainly rested,

[8] *Op. Ined.* p. 1.

the *Opus Maius, Opus Minus* and the *Opus Tertium*. With them he sent a fourth, which is supposed to be lost.

The purpose revealed in these works is one of sublime audacity. The obscure and oppressed friar, fully conscious, as he himself says, of his insignificance, of his manifold ignorance, of his tongueless mouth and scratchy pen, silenced, buried, erased in oblivion, endeavors in all earnestness to convert to his own point of view the Head of the Church, the Vicar of the Saviour, the Lord of the entire universe! To appreciate Bacon's daring, one needs a clear comprehension of the irreconcilable antagonism between the principles which he advocated and those that governed the age in which he lived.

I have said that the characteristics of Bacon's mind which made him alien to his own age and spiritually akin to ours are in particular his attitude towards authority and his appreciation of the importance of empirical evidence. Sweeping generalizations are often only partly true, but none the less they are indispensable if one is to express salient facts in brief, and I think that, if that qualification be borne in mind, the statement will not be found misleading.

In all ages the conduct of the mass of men is largely influenced by recognition of the authority of other men, but the extent to which authority is exercised, the individuals recognized as possessing it, and the reasons by which its recognition is justified, vary from age to age. In the thirteenth century European society was organized upon a feudal basis. Theoretically, supreme authority was conferred by God upon the King, by him upon the higher nobility, and from them derived to the lower social orders. Every man was the "man" of some "lord"; his chief duty to society was that of obedience, within the prescribed limits, to his lord; the "lordless" man was an outlaw. The Church was organized upon similar principles, in a hierarchy comprising Pope, Cardinals, Bishops, Priests, Deacons and "Religious." The habit of mind corresponding to this type of organization was reflected in the world of thought. The Church

was accorded supreme authority in matters of belief. The truths it sanctioned were expressed not only in the Bible and in the decrees of Popes and of Councils, but also in the writings of the Fathers approved by the Church as "authorities," whose utterances might be quoted to prove or disprove any allegation of fact. In addition to the Fathers, certain secular and even non-Christian "authorities" were slowly winning recognition. Aristotle had but recently been accorded that rank, an influential group was striving for the recognition of Averroes and other Arabian philosophers, and Bacon complains that his own contemporaries, Alexander of Hales and Albertus Magnus, are already quoted as "authorities" in the University of Paris.

The only scientific method recognized by the Universities was essentially the method of Aristotle. Aristotle had taught that "science" in the proper sense is a body of necessary and eternal truths, consisting exclusively of certain self-evident principles together with the inferences which may be derived from them by syllogistic reasoning. Sense-experience is of importance as a means of access to the self-evident principles, but is of no independent authority whatsoever. Aristotle also recognizes the propriety of using in syllogistic reasoning, under certain circumstances and for certain defined ends, principles based upon authority, which he terms τὰ δοκοῦντα, and the method which employs them he terms "dialectic." But he expressly excludes from the scope of "science" both the principles and the conclusions deduced from them. The mediæval Aristotelians, however, placed the authorities above mentioned on a level with intuitional truths as primary sources of knowledge, and sometimes sought to justify this modification in Aristotle's scheme upon Aristotelian or Platonic principles. But to sense-experience they conceded little more importance than Aristotle had done.

This overemphasis upon the deductive method is the fatal defect in the Aristotelian theory of science. It is an excellent instrument for the classification of existing knowledge, but if not supplemented by experiment it will seldom lead to the acquisi-

tion of new knowledge. Wheresoever it has prevailed science has remained stationary, stagnant. And this is precisely the point in Aristotle's system against which Bacon directs his most telling blows. He by no means rejects the deductive method; he acknowledges its importance and employs it himself. But he does deny its adequacy, and he *places experience above it*. Experience is not merely a means of reaching intuitive principles; it is itself a source of certitude superior to that of intuition; it is indeed the *only* source of certitude; conclusions deduced from intuitional principles, even those of mathematics (!), must be verified by experience before they can be really believed. It is also the only instrument for the discovery of new truths, whether they do or do not ostensibly lie within the spheres of recognized sciences.[9]

The principle of authority Bacon criticizes with equal severity. He accepts formally, and I think sincerely, the authority of the Church and the Bible, but rejects in principle that of the Fathers and the philosophers. He does not, of course, deny that in practice the individual scholar must rely to a large extent upon the opinions of his competent predecessors in forming his own. He had indeed, himself, no little respect for the Fathers and Aristotle and is reluctant to differ from them, but he denies absolutely that their judgments are final. By numerous quotations he proves that even the greatest of the recognized authorities, such as Jerome and Augustine, repeatedly contradict both themselves and one another, and he does not shrink from the obvious conclusion that they are but fallible men. The principles laid

[9] *Opus Maius*, ii, p. 167: . . . sine experientia nihil sufficienter scire potest. Duo enim sunt modi cognoscendi, scilicet per argumentum et experimentum. Argumentum concludit et facit nos concedere conclusionem, sed non certificat neque removet dubitationem ut quiescat animus in intuitu veritatis, nisi eam inveniat via experientiæ . . . p. 168: Et hoc patet in mathematicis, ubi est potissima demonstratio. Qui vero habet demonstrationem potissimam de triangulo æquilatero sine experientia nunquam adhærebit animus conclusioni. . . . p. 202: . . . veritates magnificas in terminis aliarum scientiarum, in quas per nullam viam possunt illæ scientiæ, hæc sola scientiarum domina speculativarum potest dare. . . p. 215: Et . . . ex propriis per quæ non habet respectum ad alias scientias, sed sua potestate investigat secreta naturæ. . . p. 221: tota sapientiæ speculativæ potestas isti scientiæ specialiter attribuitur.

down by such authorities must be tested by experience before they can be finally accepted.[10]

The "experience" which Bacon thus recognizes as a third criterion of truth, in addition to the authority of the Church and the Bible, occurs in two forms, sensuous and spiritual. Sense-experience, which he often calls "experiment," includes both observation, and experiment in the narrower sense. That Bacon was aware of the importance of the experimental method is shown by his actual use of it, but it does not appear that he had ever attempted to define it and to distinguish it from mere observation.

By "spiritual experience," Bacon meant, in particular, that intuitional apprehension of spiritual truth which God accords by special revelation to certain individuals. His recognition of it is designed not merely to provide a place in his empirical scheme for his other two criteria, but also for the special revelations claimed by men of later ages. It is not unlikely that he had Brother Joachim in mind, for whose claims, as it would seem, Bacon had no little sympathy. But he also included in "spiritual experience" that immediate intuition of generalizations which Aristotle had ascribed to the "poietic" or "operating" Reason, but which Bacon believed to be the immediate operation of the Divine Intellect in the depths of the purified human intelligence.[11]

Bacon not only appeals to the Pope to accept his new principles as intrinsically sound but also presses him to take at once certain steps to ensure their ultimate success. He disclaims any desire to see them applied in any revolutionary way to existing institutions; he is quite willing that those who disagree with him should be

[10] *Opus Maius*, i, 3: . . . nulla ratione loquor de solida et vera auctoritate, quæ vel Dei judicio collata est Ecclesiæ, vel quæ ex merito et dignitate proprie nascitur in sanctis philosophie et perfectis prophetis . . . iii, p. 6: Quod per auctoritates probatum est experientia cujuslibet certius dijudicat. . . . p. 13: manifestum est quod mens humana non sufficit dare quod necessarium est in omnibus, nec potest in singulis vitare falsum nec malum. . . p. 15: Sed non solum philosophi immo sancti aliquid humanum in hac parte sunt passi. Nam ipsimet retractraverunt dictorum suorum quamplurima. . . . Sancti etiam ipsi mutuo suas correxerunt positiones et sibi invicem fortiter resistebant. . . . iii, p. 16: Quoniam igitur hæc ita se habent non oportet nos adhærere omnibus quæ audivimus et legimus, sed examinare debemus districtissime sententias majorum, ut addamus quæ eis defuerunt, et corrigamus quæ errata sunt, cum omni tamen modestia et excusatione.

[11] *Opus Maius*, ii, 169–172; i, 38–41. *Opus Tertium*, pp. 74–77, 84, 86.

free to act in accordance with their several convictions. But he implores the Pope to protect with his irresistible pontifical power Bacon himself and those who shared his views, that they may pursue their scientific work without fear of persecution, and also to provide them with the means essential to its prosecution—books, instruments, physical and chemical laboratories and astronomical observatories. He sets before him all the inducements which he thought would influence him, especially the great benefits which the Church would reap in finding the Faith buttressed by scientific knowledge and in arming herself with the weapons of war which science alone could provide wherewith to withstand the impending onslaughts of Antichrist.[12]

While Bacon was well aware that his proposals were revolutionary and would be bitterly opposed by many, it may be doubted whether he realized the full sweep of the revolution to which their adoption might lead. He seems to have regarded his two ultimate criteria of truth, authority and experience, as coördinate principles, each independent of the other. His recognition of spiritual experience as an ultimate source of truth opens the way to private judgment in matters of faith; his assertion that it is a psychological impossibility to believe with full assurance anything not established by the evidence of the senses not only makes science independent of revelation but implies the possibility of bringing revelation before the bar of science for judgment. It may be that Bacon, orthodox Churchman as he believed himself to be, never seriously contemplated the possibility of conflict between his ultimate sources of truth,[13] but it is scarcely to

[12] Gasquet *Fragment*, pp. 502–505. *Opus Maius*, i, 31–32, 399–402; ii, 221. *Opus Tertium*, 34–38, 41, 59, 85–86.

[13] That Bacon was not quite frank with the Pope, that at heart he recognized and knew he recognized no authority as superior to that of experience, is perhaps indicated by two passages found only in the Vatican manuscript 4091 (see Little's bibliography in *Roger Bacon: Essays contributed by various writers on the occasion of the Commemoration of the Seventh Centenary of his Birth*, collected and edited by A. G. Little, Oxford, 1914, p. 385, n. 1), the concluding sentences of which express nearly the same idea. The first reads (Bridges, iii, 180): "And if the syllogism (*argumentum*) does not suffice for the certification of truth, much less does authority suffice, for it is weaker than reason; and syllogistic reasoning has force (*argumentatio habet virtutem*) when through reason it acquires a sound foundation. This (experimental) science, therefore, aims to show that no confidence should be placed

be believed that in the animated debates of the University of Paris so vulnerable a point in his doctrines had been overlooked. Bacon must have known that this and many others of the beliefs to which he would convert the Pope, beliefs in astrology, for example, alchemy and magic, in the influence of the stars upon the conception of Christ and the propriety of the Church employing magic as a weapon against Antichrist,[14] would be denounced by many and influential theologians as damnable heresies. He must have known that if the Pope listened to them rather than to him, his temerity in trying to convert the Vicar of Christ might well result in sending him to the stake.

The risk was great, but the issue was worthy of the risk. For the moment the mightiest power on earth, and no other power would suffice to inaugurate the reforms which Bacon had in view, was lodged in the hands of a man singularly enlightened, conscientious, strong of will. To win his approval might be difficult, but it was not beyond the range of possibility. Bacon saw the unique opportunity, and, regardless of personal danger, seized it. If he had succeeded, he probably would have hastened by several centuries the dawn of modern science.

It is this that gives Roger Bacon his unique position in mediæval thought. Of all the millions that lived between the downfall of the ancient culture and the dawn of modern science, he alone not only discerned clearly the intellectual evils of the age and pointed out the way of escape, but at the risk of his life strove to turn the tide of history into that new channel.

But Bacon failed. The *Opus Maius*, at least, reached the Vatican, for Monsigneur Pelzer recently discovered in the Vatican Library the actual copy despatched by Bacon to the Pope with his autograph notes upon the margin; but there is still nothing to show even that the Pope read the books, much less that he was

in syllogism or authority unless one has some empirical evidence of greater or less weight (*vult docere quod non est confidendum argumento aut auctoritati nisi aliqua experientia fortis vel levis habeatur*)." The two passages may have been expunged to avoid offence, but it may also be that Bacon removed them because he really had in mind only human, fallible authorities and saw that his words included the authority of Church and Scripture.

[14] *Opus Maius*, i, 267–268, 402.

favorably impressed by them. Only a few months thereafter, November 29, 1268, Pope Clement died, and with him died Bacon's hopes. Of the next ten years of his life little is known. To these years are referred several of his works, notably (1272) the *Compendium of the Study of Philosophy*, in which the bitterness of a disappointed and despairing man finds vent in savage denunciation of clergy and laity, high and low alike, for their cupidity and viciousness. Nine years after Pope Clement's death the final blow descended. In 1277 the Bishop of Paris issued a sweeping condemnation of heresies alleged to be then prevalent at the University, especially astrology, magic and Averroism. An anonymous reply, attributed with great probability by Father Mandonnet to Bacon,[15] defends the study of science, including astrology and magic, and accuses the ecclesiastical authorities of ignorance and bigotry. Bacon had for years, by his repudiation of authority and pursuit of forbidden lore, been accumulating the materials for an explosion, and this audacious book was, in all probability, the spark that provoked it. In 1277 he was sentenced to prison by the Minister-General, Jerome of Ascoli, afterwards (1288-92) Pope Nicholas IV, and his doctrines were condemned as "dangerous."[16] Only once thereafter, fifteen years after his sentence, his voice speaks again in *Compendium Studii Theologie*, recently published, dated 1292. Nothing is known as to the place or duration of his imprisonment, although it is quite generally assumed that he was released in 1290 or 1292, when, as is known, the newly elected Minister-General of the Order, Raymond Gaufredi, liberated other monks who had been sentenced at the same time and for similar offences. A confused

[15] Mandonnet P.,: *Roger Bacon et le Speculum Astronomiæ* (1277), in *Revue néo-scolastique*, xvii, 313-335 (No. 67, août 1910); *Siger de Brabant*, 2ème éd. (1911), pp. 238–248.

[16] Since the fact of Bacon's imprisonment has been disputed, I reprint Mr. Little's translation (*Essays*, p. 26) of the entry in the *Chronicle of the XXIV Generals* (the Latin text will be found in Bridges, iii, 158): "This Minister-General, brother Jerome, by the advice of many friars, condemned and reprobated the teaching of Friar Roger Bacon of England, master of sacred theology, as containing some suspected novelties, on account of which the same Roger was condemned to prison—commanding all the friars that none of them should maintain this teaching but should avoid it as reprobated by the Order. On this matter he wrote also to Pope Nicholas (III), in order that by his authority that dangerous teaching might be completely suppressed."

and seemingly self-contradictory note in a manuscript of one of Bacon's alchemical works also attributes his release to Raymond. The best authority for the date of Bacon's death, John Rous, states that he was buried in the Grey Friars at Oxford, June 11, 1292.

The greater part of Bacon's scientific work probably was done, as I have shown, during the years 1237 to 1257. After he became a friar he must have been seriously hampered by lack of money and the opposition of his superiors even before his imprisonment; thereafter it is difficult to imagine how he could have carried on much important experimental work. As to the actual results attained by him during those years of labor, little evidence has hitherto been available. More than once he speaks of himself as being in possession of important secrets of science,[17] which he feels obliged to conceal from the vulgar, and in many passages he specifies some of the marvellous achievements, possible or actual, of experimental science. Among them are explosives, incandescent lights, a small instrument for the multiplication of power, the use of mirrors and lenses to make small objects seem large and large small, distant objects to seem near and near distant, to make images appear in the air and to set fire to distant objects by focussing the rays of the sun upon them. It is not impossible that these discoveries were known to him. But these statements are associated with others which cannot be so interpreted, as, for example, that a magnet attracts all metals as well as iron, that vinegar attracts a falling stone, that the severed parts of plants and animals exert reciprocal attraction one upon another. It is indeed quite evident that Bacon had been so deeply impressed by discoveries actually known to him that he had adopted an attitude of uncritical credulity as regards alleged achievements of science; he was, as he frankly admits,[18] ready to believe anything of the kind if reported upon what he took to be good authority. He seems also to have been

[17] *De Secretis Operibus Artis et Naturæ* in Brewer, *Opera Inedita*, p. 545. *Un Fragment inédit de l'Opus Tertium*, ed. Duhem, pp. 182–183; *Part of the Opus Tertium*, ed. Little, pp. 80–82.

[18] Duhem: *Op. cit.*, pp. 152–153; Little: *Frag. Op. Tert.*, p. 49; *Opus Maius*, ii, p. 219.

willing to accept as accomplished fact many achievements which were as yet merely inferred, from accepted principles, to be possible, and as the accepted principles were often quite wrong, some of Bacon's predictions and assertions seem, even in this age of invention, absurdly mistaken. One is not, therefore, justified in taking those of his statements which seem to imply knowledge of the microscope and telescope as affording trustworthy evidence that he had any empirical knowledge of those instruments.

There are, however, certain other considerations, hitherto generally ignored by writers on the subject, which make it probable that Bacon's statements suggesting empirical knowledge of the microscope and telescope are something more than mere deductive forecasts. These considerations tend, indeed, to show that Bacon was the first man known to us, with the possible exception of his friend Peter of Maharncuria, who possessed the qualifications which the discoverer of those instruments should possess.

Bacon, of course, shared his contemporaries' knowledge of the magnifying properties of the simple lens and of concave, spherical and parabolic mirrors. They had been known for centuries and are, for example, fully explained by geometrical principles in the chief authority used by Bacon, Alhazen. Some of these explanations had already been formulated in the terms still used, *e. g.*, that the apparent size of the object depends upon the size of the visual angle, and that the size of that angle is modified by convex and concave mirrors and by lenses.

But Alhazen treats these properties merely as capable of causing illusions of vision; neither he nor Vitelo betrays any consciousness of the possibility of applying them to the practical end of increasing the power of vision as regards very small or very distant objects. This idea was perfectly familiar to Bacon. He recurs to it in his works again and again. He believed that telescopes had been made in the past; that they had, for example, been used by Julius Caesar in order to spy upon his enemies in Britain from the coasts of France,[19] and was eager to see them

[19] *Opus Maius*, ii, 165; *Opera Inedita*, p. 534.

again constructed in order to aid the Church in her war against Antichrist.[20]

The failure of Bacon's predecessors to refer to this important possible application of optical theory to practice is not to be explained by mere preoccupation with theory, for they devote considerable space to the no less practical application of theory to the construction of burning mirrors, but by the fact that the idea never had occurred to them. Yet the honor of first conceiving it does not belong to Bacon, but to his great teacher, Robert Grosseteste, who, in his treatise *On the Rainbow and the Mirror*, deduces this possibility from the laws of optics and states it in language that leaves nothing to be desired in clearness and breadth of generalization. In fact, the passage so often quoted to prove Bacon's knowledge of the microscope and telescope is nothing more than a condensed quotation from Grosseteste's work.[21]

[20] *Opus Maius*, ii, 221–222.

[21] This vitally important fact seems to have been first observed by Baur (*Die Philosophie des Robert Grosseteste*, in Baeumker's *Beiträge zur Gesch. d. Phil. d. Mittelalters*, xviii (1917), p. 114, n. 1). Comparison of the two texts throws no little light upon the methods by which some of Bacon's forecasts were reached:

BACON,

Opus Maius, ii, 165.

"We can give transparent substances such shapes and arrange them in such a way with reference to our sight and things that the rays will be broken and bent whithersoever we will, so that we may see a thing near or far under any visual angle we will. Thus at an incredible distance we might read the tiniest of letters and count dust or sand

GROSSETESTE,

(*de Iride, ed. Baur, Beitr.*, ix (1912), 74, 1–7.

"For this part of Perspective, when well understood, will show us the way in which we may make very distant things seem very near, and how we may make very large things near at hand seem very short, and how we may make small things far off seem as large as we please, so that it may be possible for us to read the tiniest of letters at an incredible distance or count sand or grain or grass or any tiny objects.

(*ll.* 7–12, *the fact of refraction;* 12–24, *deductive proof that refraction is necessary;* 25–p. 75, 5, *the angle of refraction is half that between the prolongation of the ray and the perpendicular to the surface;* 6–14, *apparent location of image.*)

(*Inferences*, 15–32). If then these points have been made clear, namely, (1) the size of the angle of refraction at the point of contact between two transparent substances, (2) the place of appearance of an object seen through several such substances, and if one add to these the principles which the student of optics borrows from the natural philosopher, namely, (3) that the apparent

It would, then, appear that Bacon and his friend Peter had a definite conception of the end to be attained, an eager desire to attain it, and the greater part of the requisite theoretical knowledge. There remains one other essential condition, command of the practical mechanical skill without which such instruments could not be made. There can be no doubt but that at that time such skill was rare in western Europe. Bacon himself says:[22] "These instruments are not made among the Latin-using peoples and could not be made (*fierent*) for two hundred pounds; no, nor for three hundred." It was no doubt for this reason that Peter of Maharncuria made with his own hands the first concave parabolic mirror made in Europe and that Bacon himself was compelled to manufacture his own mirrors.[23] It is likely that the

by reason of the magnitude of the visual angle under which we see them, and the largest bodies, though near, we would scarcely see at all because of the smallness of the angle, for distance does not contribute to these appearances, except incidentally, but the size of the angle."

size, situation and position of the object seen depend upon the size of the visual angle and the situation and position of the rays, and also (4) that great distance does not make an object invisible, except incidentally, but the smallness of the visual angle, then, (1) by geometrical reasoning, given a transparent substance of known size, shape and distance from the eye, it will be perfectly manifest what the apparent place, size and position will be of an object of known distance, size and position, and (2) to the same persons will be manifest the method of so shaping transparent substances that they will receive the rays proceeding from the eye at any visual angle one pleases and will constrain the rays received in any way one pleases upon the visible objects, whether they be large or small, distant or near at hand. And thus all visible objects will seem to be in any situation one pleases and of any size one pleases, and, if one pleases, one may make very large objects seem very short and distant objects one may make to seem large and perfectly perceptible by sight."

But the deductive form of the reasoning and the assumption that the law of refraction is analogous to that of reflection and is the same for all substances (Bacon knew better: *Non tamen dividit illum angulum semper in duas partes aequales, licet hoc senserunt aliqui, quoniam secundum diversitatem densitatis medii secundi accidit major recessus et minor fractionis ab incessu recto*, *Opus Maius*, ii, 466), indicate that Grosseteste is merely predicting possibilities without empirical knowledge of the facts.

[22] *Opus Tertium*, p. 35.

[23] *Opus Maius*, i, 116; *Opus Tertium*, pp. 46, 111, 113, 116; Little: *Essays*, p. 6, n. 3. Bacon gives some interesting details as to the making of these mirrors, which were so important to the history of science. The first was unfinished early in 1266 (*Opus Maius*, i, 116), and he suggests that the Pope might command (and so ensure) its completion. When he first speaks of it in the *Opus Tertium*, about a year later, it is nearly done: soon thereafter it is completed. Peter tried to follow the instructions of the book *De Speculis comburentibus* (by Alhazen, see E. Wiede-

spherical crystal lens which he sent the Pope as a gift, by John was also his own handiwork. At all events one may infer that such a lens was a rarity which the Pope probably would not possess and could not easily procure, and also that Bacon either had or could procure others.

Since the first concave parabolic mirror was not made until 1268, it follows that Bacon could not have had a mirror of that type wherewith to experiment at an earlier date, but it by no means follows that he had no concave spherical mirror; on the contrary it is probable that the comparatively easy task of making the latter was successfully accomplished before the more difficult was undertaken. And if he possessed lenses and con-

mann, *Zur Gesch. d. Brennspiegel* in *Annalen d. Physik u. Chemie*, N. F., xxxix, 126–128), but "because the author has deliberately concealed much of the method, saying that he has put the remainder in another book, which has not yet been translated for the Latin-using peoples," many difficulties were encountered. But after devoting no less than three years to the work, to the exclusion of all his studies and other necessary pursuits, during which he expended upon it 100 Parisian pounds (equivalent to about $2500), he at last succeeded. "He would not have left the task undone for 1000 marks, not only for the view it gave him of the exquisitely beautiful power of science, but also because he could thereafter make better ones at less expense, for experience had taught him what he had not known before. Nor is it surprising that he spent so much money and labor on his first task, for no one among the Latin-using peoples before him had known how to go about it, and it is astonishing that he dared attempt a task so unfamiliar and so arduous." Of his own experience Bacon says: "The first mirror cost 60 Parisian pounds, which are worth about 20 pounds sterling, and afterwards I managed to make a better one for 10 Parisian pounds, that is for 5 marks sterling, and after that, as a result of my diligent experimentation with them (*diligentius expertus in his*), I perceived that still better ones could be made for 2 marks or 20 shillings or even for less." Reckoned in purchasing power of the present day, Bacon's mirrors cost him respectively about $1500, $250, $100, $75 "or less."

One may even venture a conjecture as to the improvements in method which so greatly reduced the cost of the mirrors. Alhazen (since his book is not accessible to me I here depend upon Wiedemann's outline of its contents) directs that the parabolic mirror be built up out of sections of a paraboloid of revolution, but refers to another work for a description of the instrument by which these sections are to be constructed. This must be the omission to which Bacon above refers, and this is the method which Peter used. Vitelo, Bacon's contemporary, gives (ix, 44) a much simpler method, which is, essentially, the making of a steel file with parabolic edge wherewith the cavity which is to be polished as a mirror is filed in a block of iron. Bacon (*De Speculis*, ed. Combach, 1614, pp. 202–204), by a similar method, makes a ruler with a parabolic edge and turns the cavity in a block of wood in such manner that all points of the surface will conform to the edge of the ruler. It is not impossible that Vitelo's method is that to which Bacon refers as invented by Peter, which he probably himself used in the construction of his first mirror; the substitution of wood for steel and iron as the materials to be worked would explain the reduction in the cost of the other mirrors (*Opus Tertium*, p. 111).

cave spherical mirrors, provided the latter were small portions of spheres of large radius, he had the materials necessary to the discovery of the compound microscope, the refracting and reflecting telescope. For, although a parabolic mirror makes a better reflector for a telescope than a spherical, one of the latter type may be so made as to give very satisfactory results. Sir Isaac Newton, indeed, who rediscovered the reflecting telescope, always used in his instruments a mirror of this kind.

If, then, Bacon had the fundamental theoretical principles, the requisite mechanical skill, a clear conception of the end to be attained and a determination to succeed, it is not in the least improbable that he did succeed.

But the question is not one of mere probability. It has long been known that there exists direct, positive and uncontradicted evidence to the fact that Bacon left in writing instructions for the making of a "perspective glass" or reflecting telescope, and that, in accordance with those instructions, Leonard Digges made such a telescope prior to 1571. Digges's telescope was constructed of mirrors set at due angles, one to the other, together with a lens "for the multiplications of beames," that is, for the magnification of the focal image produced by the concave mirror. It was of sufficient power to bring out the details of objects not clearly distinguished by the naked eye at a distance of seven miles with a degree of distinctness which was satisfactory to its manufacturer and his friends.[24]

[24] The extreme rarity of Digges's books, which is perhaps one of the reasons for the general disregard of the evidence which they contain, is sufficient excuse for quoting the relevant passages in full:

"A Geometrical Practical Treatize named Pantometria, divided into three Bookes, Longimetra, Planimetra, and Stereometria . . . first published by *Thomas Digges* Esquire and dedicated to the Graue, Wise and Honourable, Sir *Nicholas Bacon* Knight, Lord Keeper of the great Seale of England." (First edition, 1571; quotations from second edition, London, 1591. From the letter of dedication it appears that this work was one of several which Leonard Digges, Thomas's father, "in his youthe time long sithens had compiled in the English tongue," but Thomas has "supplied such partes of this Treatise as were leaft obscure or vnperfect, adioyning therevnto a Discourse Geometricall of the fiue regulare or Platonicall bodyes.")

P. 28: "But marueilous are the conclusions that may be performed by glasses concaue and conuex of Circulare and parabolicall formes, vsing for multiplication of beames sometime the aide of Glasses transparent, which by fraction should vnite or dissipate the images or figures presented by the reflection of other. By these kinde of Glasses or rather frames" (*i.e.*, systems) "of them, placed in due

Leonard and Thomas Digges belonged to a Kentish family of gentry which had played an honorable part in the history of England for more than two hundred years. They were themselves sound scholars, reputed the best mathematicians of their time in England and highly esteemed by such shrewd judges of character as Sir Nicholas Bacon and Sir Francis Walsingham. Their evidence, until discredited by more trustworthy evidence to the contrary, is entitled to full credence, and establishes the fact that Roger Bacon left intelligible instructions in writing for the construction of a reflecting telescope.[25]

Angles, yee may not onely set out the proportion of an whole region, yea represent before your eye the liuely image of euery Towne, Village, etc., and that in as little or great space or place as ye will prescribe, but also augment and dilate any parcell thereof, so that whereas at the first apparance an whole Towne shall present it selfe so small and compact together that yee shall not discerne anye difference of streates, yee may by application of Glasses in due proportion cause any peculiare house, or roume thereof dilate and shew it selfe in as ample forme as the whole towne first appeared, so that ye shall discerne any trifle, or reade any letter lying there open, especially if the sunne beames may come vnto it, as plainely as if you were corporally present, although it be distante from you as farre as eye can descrie: But of these conclusions I minde not here more to intreate, hauing at large in a volume by it selfe opened the miraculous effects of perspective glasses." (This volume was never published.)

Op. cit., second page of Preface (by Thomas Digges): ". . . *my Father by his continuall painfull practises, assisted with Demonstrations* Mathematicall, *was able, and sundrie times hath by proportionall Glasses duely situate in conuenient Angles, not onely discouered things farre off, read letters, numbred peeces of money with the verye coyne and superscription thereof cast by some of his freends of purpose upon Downes in open Fields, but also seuen Myles off declared what hath beene doone at that instant in priuate places: Hee hath also sundrie times by the Sunne beames fixed* (fired?) *Powder, and dischargde Ordinance halfe a Mile and more distante, which things I am the boulder to report, for that there are yet liuing diuerse (of these his dooings)* Oculati testes, *and many other matters farre more strange and rare which I omit as impertinent to this place.*"

"An Arithmeticall Militare Treatise, named *Stratiokos:* . . . Long since attempted by *Leonard Digges* Gentleman, Augmented, digested, and lately finished, by *Thomas Digges*, his Sonne." (First edition, London, 1579.)

P. 189 (appendix by Thomas): "And such was his (Leonard's) Foelicitie and happie successe, not onely in these Conclusions, but also in the Optikes and Catoptrikes, that he was able by Perspectiue Glasses duely scituate vpon conuenient Angles, in such sorte to discouer euery particularitie in the Countrey rounde aboute wheresoeuer the Sunne beames mighte pearse: As sithence Archimedes (Bakon of Oxforde only excepted) I haue not read of any in Action euer able by meanes naturall to performe ye like. Which partely grew by the aide he had by one old written booke of the same Bakons Experiments, that by straunge aduenture, or rather Destinie, came to his hands, though chiefelye by conioyning continual laborious Practise with his Mathematical Studies."

[25] It has not, I think, hitherto been observed that Dr. John Dee, admirer of Bacon and collector of his works, in whose possession the Voynich manuscript almost certainly was, who was also an intimate friend of Thomas Digges and probably of his father, also had a "perspective glass." On p. 1 of his private diary

This conclusion is confirmed by the legend attached to Bacon's drawing of a spiral nebula in the Voynich manuscript, which, if it has been correctly deciphered, states that the object in question was seen "in a concave mirror," that is, a reflecting telescope. But this legend is so difficult to read that I would not adduce it as independent evidence of Bacon's possession of a telescope until the reading has been revised and verified.

That Bacon possessed a telescope I regard as an established fact, independently of the new evidence afforded by the Voynich m nuscript. But for his possession of a compound microscope, or even of a simple microscope of sufficient power to enable him to make discoveries of real importance, there has been hitherto no evidence at all. At most one may say that, since he had lenses and was familiar with the idea of arranging lenses in such manner as to increase the size of the visual angle, there is no improbability in the hypothesis that he succeeded in so arranging them as to make the first compound microscope.

The doubt that has overhung the subject is now, in large part, dispelled by Mr. Voynich's discovery. That the author of the manuscript possessed both a telescope and a microscope, both

(*A True and Faithful Relation of What passed for many Years Between Dr. John Dee . . . and Some Spirits*, edited by Meric Casaubon, London, 1659) Dr. Dee describes, May 28, 1583, a little girl-spirit as "playing by herself, and diverse times another spake to her from the corner of my study by a great Perspective-glasse." I am indebted to Mr. Voynich for two other significant scraps of information. Thomas Harriot, afterward famous as a mathematician, was in his youth a member of the group of scientists at Elizabeth's court and accompanied the second expedition sent by Sir Walter Raleigh to "Virginia" as geographer, remaining there a year, 1585–1586. In his account of the country (Hakluyt, *Voyages*, vi, 189, in the *Everyman's Library* edition) he says: "Most things they (the Indians) sawe with us, as Mathematicall instruments, sea Compasses, the vertue of the load-stone in drawing yron, a perspective glasse whereby was showed many strange sights, burning glasses . . . were so strange to them . . . they thought they were rather the workes of gods than of men," etc. Dee also had a trick mirror, the theory of which was known to Bacon (*Opus Maius*, ii, 138). This mirror was much admired by Queen Elizabeth (Dee's *Private Diary*, Camden Soc., 1842, pp. 29–30) and was ultimately given to Emperor Rudolph. I agree with Mr. Voynich's inference that this mirror had its origin, as well as the telescopes owned by Harriot, Dee and Digges, in the same Bacon manuscript mentioned by Thomas Digges, and that that manuscript probably came from Dee's collection of the Bacon manuscripts.

of considerable power, is established by the drawings which it will be my privilege to show you. That the author was Roger Bacon is established by the fact that the alphabets which I worked out from the Key on the last page of the manuscript when applied to the cipher elements interpolated into the Key spelled out the name *R Baconi*.[26]

But whether the microscope with which he saw the spermatozoa and the cells which he has so clearly depicted in the drawings was of the simple or the compound type will remain an open question until the manuscript has been deciphered. Some students are of the opinion that a simple lens of high power would have sufficed; whether this is the case or not I must leave to the decision of those more competent to judge than I am.

It would appear, then, that it was only during the twenty years from 1237 to 1257 that Bacon enjoyed comparative freedom and possessed sufficient money for the prosecution of his scientific work. During those years he made what he regarded as scientific discoveries of the utmost importance, and it is extremely probable that some form of the telescope and the microscope were among them. Thereafter, for thirty-five years or more, he worked, when permitted to work at all (for at least some of those years were passed in prison), under severe restrictions, closely watched by suspicious and hostile eyes. The majority of his contemporaries, and very many among those of position and power, would have seen in his achievements conclusive proof of commerce with the devil, and many, even of the more enlightened, would have found in his teachings equally good reasons for sending him

[26] The first section of the Key reads: *michiton oladabas multos te tccr cerc portas.* The *o* of *multos* is built up out of three elements, *c*, *e*, *q*, which form a monogram for *a*. Subtracting the Latin sentence *Michi dabas multas portas*, one has as residuum the interpolated cipher elements *ton ola te tccr cerc.* Between June and September, 1919, I worked out from the Key a system of biliteral alphabets and assigned them trial values based upon the usual alphabetic order. Early in September it occurred to me to apply these values to the cipher syllables above given. I found that *tccr cerc* spelled *-coni*, that *ton*, analyzed into *to on* spelled the bilateral symbol *sl*, to which I had given the values *r* or *q;* that *ol la* spelled *iq*, the value of which was *e* or *b*. Thus I had at once as a possible reading *R B coni.* But the symbol *te* was not in my system of alphabets at all. That its value is *a* is now assured by many hundred occurrences.

to the stake.[27] He must, therefore, as a mere ordinary precaution, have been compelled to keep these discoveries secret, either locked up in his own breast or at most communicated to a few trustworthy friends. What would have been his reaction against such circumstances as these? What course of action would they have driven him to adopt?

In the Voynich manuscript is found the answer to these questions, but any one familiar with Bacon's works could have predicted his course of action without this concrete evidence of what he actually did.

Bacon's reticence about his discoveries, even before he entered the Franciscan Order, was not entirely, nor, I think, chiefly, due to fear of persecution; it was grounded in his most sacred convictions. He was profoundly religious; in everything he saw the hand of God. The mere fact that the secrets of Nature had then so long been hidden is to him conclusive proof that God wills it so to be. The solitary scholar who succeeds in lifting a corner of the veil has, he believed, been admitted by God to His confidence, and is thereby placed under the most solemn obligation conceivable to make no use of his knowledge which God would not approve. Especially must he be careful not to betray it to the vulgar. God has indeed Himself, with special regard for this contingency, directly inspired scientific men, when writing of their discoveries, to conceal them either in obscure language such as was used by philosophers, or in peculiar technical terms such as were used by alchemists, *or in cipher*.[28]

[27] Even so enlightened a scholar as Dante, writing within a few years of Bacon's death, regards the practice of alchemy as an offence punishable by damnation. *Inf.*, xxix, 118: One of the damned confesses,

> *Ma nell' ultima bolgia delle diece*
> *Me per l'alchimia che nel mondo usai,*
> *Dannò Minos, a cui fallir non lece.*

Dante mentions several persons who had recently been burned, either as alchemists or as would-be counterfeiters by alchemical means.

[28] *Opus Maius*, i, p. 11: "Many are called, but few chosen, for the reception of philosophical truth, and likewise for that of scientific truth."

Ib., p. 10: "One should not cast pearls before swine, for whosoever reveals mysteries derogates from the majesty of the universe, and those things which the mob is permitted to share do not remain secrets. . . . Hence, Aristotle in the *Book of Secrets* says he would be breaking the heavenly seal if he were to betray the secrets of Nature."

Duhem, *Fragment*, p. 182: Little, *Fr. Opus Tertium*, p. 81: "It is foolish to offer

That Bacon had devoted much study to the subject of ciphers is apparent from the eighth chapter of his *Letter on the Secret Works of Art and the Vanity of Magic*, in which he enumerates and describes no less than seven modes of concealing ideas:[29] "The man is insane who writes a secret in any other way than one which will conceal it from the vulgar and make it intelligible only with difficulty even to scientific men and earnest students. On this point the entire body of scientific men have been agreed from the outset, and by many methods have concealed from the vulgar all secrets of science. For some have concealed many things by magic figures and spells; others by mysterious and symbolic words. For example, Aristotle in the *Book of Secrets* says to Alexander, 'O Alexander, I wish to show you the greatest secret of secrets; may the Divine Power help you to conceal the mystery and to accomplish your aim. Take therefore the stone which is not a stone and is in every human being and in every place and at every time, and it is called the Egg of the Philosophers, and Terminus of the Egg.' Innumerable examples of the kind are to be found in many books and divers sciences, veiled in such terminology that they cannot be understood at all without a teacher. The third method of concealment which they have employed is that of writing in different ways, for example, by consonants alone, so that no one can read it unless he knows the words and their meanings. In this way the Hebrews and the Chaldæans and Syrians and Arabs write their secrets. Indeed, as a general thing, they write almost everything in this way, and therefore among them, and especially among the Hebrews, important scientific knowledge lies hidden. For

an ass lettuce when thistles are good enough for him. The mob and its leaders know not how to make proper use of precious things, but pervert all to evil ends, for one wicked man, if he knew these secrets, could throw the whole world into confusion. The inmost secrets of science have therefore always been hidden by scientists, and have been written in such manner that even the wisest of men can penetrate the knowledge of them by hard study only. This *God has ordained and has inspired all to whom He has given these secrets*, and every one of them clearly perceives that, for the above-said reasons, they are not to be communicated. I therefore may not write these things in contravention of the will of God and the teaching of the wise in such manner that they could be understood by any and every one."

[29] Brewer: *Opera Inedita*, p. 544.

Aristotle in the book above mentioned says that God gave them all scientific knowledge before there were any philosophers, and that from the Hebrews all nations received the first elements of philosophy. . . In the fourth place, concealment is effected by commingling letters of various kinds; it is in this way that Ethicus the astronomer concealed his scientific knowledge by writing it in Hebrew, Greek and Latin letters in the same written line.[30] In the fifth place, certain persons have achieved concealment by means of letters not then used by their own race or others but arbitrarily invented by themselves; this is the greatest obstacle of all, and Artephius has employed it in his book *On the Secrets of Nature*.[31] In the sixth place, people invent not characters like letters, but geometrical figures which acquire the significance of letters by means of points and marks differently arranged; these likewise Artephius has used in his science.[32] In the seventh place, the greatest device for concealment is that of shorthand, which is a method of noting and writing down as briefly as we please and as rapidly as we desire; by this method many secrets are written in the books of the Latin-using peoples. I have thought fit to touch upon these methods of concealment *because I may, perhaps, by reason of the importance of my secrets, employ some of these methods,* and it is my desire to aid in this way, at least *you*, to the extent of my ability."

It is quite characteristic of Bacon that this specious pretence of good-will really masks a deliberate intention to deceive, for the list contains not a hint which would aid any one in unravelling the system of ciphers which he himself uses; it is indeed drawn up expressly to mislead the would-be decipherer by directing his attention to forms of cipher which have no place in that system.

Finally, we know that Bacon was deeply concerned to hand down to future generations the results of his labors. The whole

[30] The cipher alphabets extant in manuscripts of Ethicus (fac-similes in Wuttge's edition of *Aithikos*) are not of this kind.

[31] What purport to be the ciphers of Artephius will be found in Cardanus's *de rerum vanitate*, lib. xvi, c. 90 (*Opera Omnia*, tom. iii, p. 312).

[32] This seems to be the cipher described by S. L. MacGregor Mathews (*The Kabbalah Unveiled*, third Impression, New York, 1912, pp. 10–11) as the "Qabalah of the Nine Chambers."

burden of the voluminous works addressed to Pope Clement in 1267 is for official recognition of that work, for complete reformation of the conditions under which it was prosecuted, for repression of ignorant opposition, for endowment of research. But long before his appeal to the Pope, Bacon had taken steps to ensure the perpetuation of his ideals. He had probably taken into his confidence a few friends of his own generation, but he had certainly looked beyond his generation. He mentions specifically two boys whom he had trained in his methods, and it is not unlikely that there were others. One of these two, John, Bacon says he found on the streets of Paris at the age of fifteen, penniless and starving. For six years he has provided him with food, clothing and education, and now, at the age of twenty-one, he sends him to Rome to the Pope as his trusted representative and bearer of the most precious of his manuscripts, informing the Pope that John is more competent than any living scholar, however learned, to explain to him any thing he may find difficult of comprehension. Bacon's object in training these boys, he himself explains,[33] was that "they might be useful vessels in the Church of God in ordering aright, by the grace of God, the entire course of study of the Latin-using peoples." In others words, they were to be Bacon's torch-bearers, handing on to the next generation the flame kindled and nurtured by him, the spirit of pure science as we understand it today.

It was then, in all probability, for John or for some other such trusted friend or friends that Bacon wrote this precious manuscript, which now, after more than six hundred years of concealment, has been rescued by the intuitive genius of Mr. Voynich from imminent peril of destruction, and has been brought to light for the instruction of our own generation. Twenty years of free and independent research, during which he had often experienced that rapture of discovery which he so feelingly describes, had been followed by long years of hampering restrictions, enforced silence, and daily intensified despair. He felt himself buried alive, and the fruits of his labors seemed destined to be

[33] *Opus Maius*, ii, 171.

finally buried with him in the Friary Church at Oxford. It was under these circumstances that he conceived the plan which was to thwart his opponents. He had long since devised and used a cipher of extraordinary ingenuity in which at once to record his discoveries and to conceal them from prying eyes. He resolved to embody in a single work, concealed in that cipher, his most important discoveries together with his own interpretation of their significance, to provide it with a key so constructed that it could be understood and used only with the aid of oral instruction, and to entrust the secret of its use to some faithful friend in the hope that in a more sympathetic age the fruits of his labors would come to light. That age was not to dawn as soon as he had hoped, and the secret probably died with the friend to whom he entrusted it. But at last, after the lapse of more than six hundred years, the dawn has come and the secret of the cipher has been unravelled. Difficulties, formidable difficulties, still bar the way to the reading of Bacon's manuscript, but they are less formidable than those which have been overcome. These also must be overcome before the full story can be told. But even with the text unread the drawings alone throw a flood of light upon the achievements of Roger Bacon. They confirm to the full the inference drawn by a few scholars from existing evidence, but denied by the majority, that he possessed and was probably the discoverer of the telescope and the microscope; they prove that he had seen anatomical and astronomical objects never seen by the human eye before, and not to be seen again for centuries, and show that he is here trying to weave them into and interpret them by a preconceived system of ideas drawn in the main from the Platonic tradition. Roger Bacon at last stands revealed as the true forerunner of modern science, as one of the greatest of the many men of genius born of the gifted English race.

[NOTE.—The second part of the lecture comprised a description of the Voynich manuscript, followed by the exhibition on the screen of a series of slides, representing the most important drawings, with the colors of the original reproduced as accurately

as possible and accompanied by such explanations as the lecturer felt justified, at the present stage of the investigation, in suggesting. The lecturer's primary object was to show that the series of interpretations which he offered, the essential feature of which was recognition of the fact that the author is here endeavoring to combine information obtained by means of the microscope and telescope with a preconceived and well-known theory, provided an intelligible and coherent explanation of the drawings as a whole, notwithstanding a considerable number of as yet unexplained features. It is to be regretted that the high cost of printing forbids the reproduction of this section in its entirety.

The explanations offered were in many cases derived from the reading of the legends, but the legends were in no case alleged as evidence of the correctness of the interpretation, for the following reasons: The text is buried under no less than six layers of cipher. Two of these can be eliminated, but there remain four operations which must be performed before the text can be read. Two of the four are merely mechanical, but two, the first and last, present difficulties which are as yet overcome only in part. The actual letters of the cipher text are minute shorthand characters, usually written and to be read only with the aid of a microscope, with which the apparent characters are built up. These letters are extremely difficult to see distinctly, and, as several closely resemble one another, mistakes in reading them are at present unavoidable. Every such mistake usually yields two wrong letters in the final text. The letters of this final text, again, are always more or less displaced. Usually they are not displaced to such an extent as to make the words which they represent unrecognizable, but in many cases there is considerable doubt as to what word Bacon intended to be read. Therefore, until more progress has been made toward the removal of these difficulties no confidence is to be placed in the readings of the text except in the comparatively few cases in which they give facts unknown to the reader and afterwards confirmed, and, even in those cases, the confirmation attaches to the general idea only, not to the exact wording.]

The Voynich manuscript is a small quarto, the leaves of which vary in size but average about nine inches by six. They are numbered in a sixteenth century hand; the last bears the number 116, but eight leaves are missing. Several leaves are folded, thus being made equivalent to two or more, and one is a large folding sheet equivalent to six leaves. The manuscript contains at present the equivalent of 246 quarto pages; if the eight missing leaves be reckoned at two pages each it must originally have contained not less than 262 pages. The last page contains the Key only, and f.57v bears a diagram, not yet deciphered, which is probably a Key; of the remaining 244 pages, 33 contain text only, while 211 contain drawings, usually touched up with water-color, and nearly always accompanied with some text. The parchment, ink and style of the drawings indicate, in the judgment of experts, England as the place and the thirteenth century as the time of origin. It is, on the whole, in an excellent state of preservation, although a few pages have suffered somewhat from abrasion.

Judging from the drawings, the contents of the manuscript fall into five divisions. The first and largest section contains the equivalent of 130 pages, 125 of which bear drawings of plants with accompanying text; this I term the botanical division. The second contains 26 pages of drawings, obviously astronomical or astrological, but of striking originality, few presenting any resemblance to the innumerable extant drawings relating to the same subjects. The drawings are accompanied by numerous legends, but little continuous text. The third section is still more strikingly original in character; it contains 4 pages of text and 28 of drawings, to which no parallels of any sort are known. Some persons perhaps would term them "weird," "bizarre," "uncanny," but neither these nor any other adjectives seem to me appropriate. Yet, strange as they are, they are not lacking in artistic quality; the nude little female figures with which every page is peopled are rudely drawn indeed, but there is about them a fresh vividness, an expressiveness, which places them at a wide remove from the stiffly conventional figures of contemporary

miniature painting. The leading topic dealt with in this section is the procedure by which the soul becomes united to the body; I term it "biological." The fourth division contains on 34 pages drawings of flowers, fruits, leaves, roots, and of the receptacles used by pharmacists for their drugs; it is almost certainly pharmaceutical in character. The fifth division contains 23 pages of text, arranged in short paragraphs, each beginning with a star. The 24th page of this division, the last of the manuscript, contains the Key only.[34]

Of these five divisions the second and third are the most important. Their common theme is the theory of the soul, and the doctrine they teach is a very ancient one. Tradition associates it with the names of Orpheus and Pythagoras; in later times it

[34] The contents may be summarized as follows:

	Leaves.	Text.	Drawings.	Missing.	Total.
Part I. *Botanical*, ff. 1–11, 13–66	65	pp. 5	pp. 125	(f. 12) pp. 2	pp. 132
Part II. *Astronomical*, ff. 67–73, of which ff. 67, 70 (each = pp. 4) = 8 ff. 68, 72 (each = pp. 6) = 12 ff. 69, 71, 73 (each = pp. 2) = 6 — pp. 26	7 ..	0	pp. 26	(f. 74) pp. 2	pp. 28
Part III. *Biological*, ff. 75–86 of which ff. 75–84 (each = pp. 2) = 20 ff. 85–86 (large sheet) = 12 — pp. 32	12 ..	pp. 4	pp. 28	0	pp. 32
Part IV. *Pharmaceutical*, ff. 87–90, 93–96, 99–102 = 12 of which 87, 88, 93, 94, 96, 99, 100 (each = pp. 2) = 14 89, 90, 95, 101, 102 (each = pp. 4) = 20 — pp. 34	12 ..	0	pp. 34	(ff. 91, 92, 97, 98) = pp. 8	pp. 42
Part V. *Text only*, ff. 103–108, 111–116	12	pp. 24	0	(ff. 109, 110) = pp. 4	pp. 28
	108	pp. 33	pp. 213	(ff. 8) pp. 16	pp. 262

was taught, in one or another of its many forms, by Plato and his contemporary Heraclides of Pontus, by Posidonius the Stoic, Cicero's master, and by Cicero himself, by Plutarch, by many of the Gnostics and of the neo-Platonic philosophers. Its essential feature is the astral origin of the soul. The soul dwelt originally in the stars, thence it descends to suffer temporary imprisonment in a material body. If it there obeys the laws of its being it will be emancipated by death and return to its blessed life on high. Bacon never refers to this doctrine in his printed works, but he must have been acquainted with it, for he had read Martianus Capella, Plato's *Timaeus* with Chalcidius's commentary, and other works in which it is mentioned.

In the greater number of the astral drawings the souls, represented by naked female figures, are depicted dwelling among the stars. The first drawing of the third section shows their descent to earth, and nearly all the remaining drawings of that section symbolize the physiological processes by means of which they are united to material bodies.

The first and fourth sections, dealing with the medicinal properties of plants and the methods of preparing from them drugs, and the astrological drawings, are probably connected with the preceding by their common reference to the problem of the prolongation of life, the "secret of secrets," the discovery of which Bacon seems to have regarded as the chief practical end of science. The chief influences affecting the duration of life Bacon believed to be the conditions prevailing at the time of conception, especially the health of the parents and the influence of the stars, the observance throughout life of the laws of hygiene and morals and the use of the "elixir of life," as it has been called by later writers.[35]

List of Slides

(1) Letter of Johannes Marcus Marci, 1665 (or 1666), presenting the manuscript to Athanasius Kircher and attributing its authorship to Roger Bacon (see p. 417).

(2) and (3) First page, showing signature of Jacobus de Tepenecz, Director of Rudolph II's Botanical Garden (died 1622), former owner of the manuscript (see p. 421).

[35] *Opus, Maius* ii, 204–213; i, 387.

(4) to (10) Plants. In (7) the lizard (?) nibbling the leaf illustrates Bacon's doctrine that animals know the medicinal properties of plants (*Opus Maius*, ii, 208).

(11) Diagram of the signs of the zodiac. Female face in center from which radiate twelve sectors, each divided longitudinally into halves, one painted blue and one studded with stars.

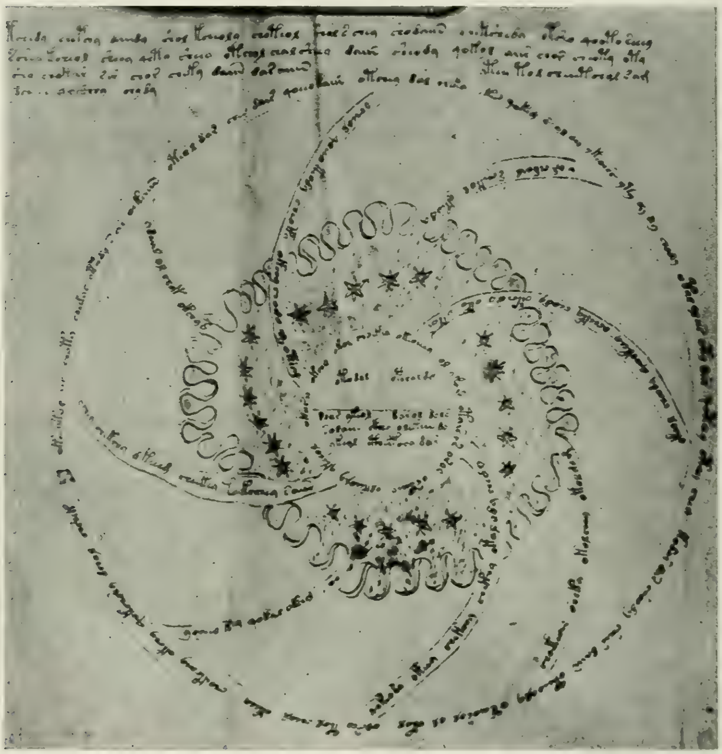


PLATE I.—Newbold.

(12) Diagram of annular eclipse, December 5, 1290 (according to legend). Center eclipsed sun with influence streaming out along axes: right lower corner, four planets with their combined influence streaming inward toward the sun along the diagonal. Other corners similar symbols (not deciphered).

(13) Plate I. Drawing of the Great Nebula of Andromeda, the first known observation with a telescope. From a central circular space, within

which is a legend, curved arms reach out toward a circular boundary, passing through masses of blue flocculi interspersed with yellow stars; here and there are irregular, greenish blotches. The late Prof. Eric Doolittle, of our Flower Observatory, told me that in his opinion it unquestionably represented a nebula, and that the man who drew it must have had a telescope. The legend is extremely difficult to decipher, but my first attempt gave the location of the object as between "the navel of Pegasus, the girdle of Andromeda and the head of Cassiopea," and stated that it was seen in a concave mirror. The Great Nebula of Andromeda lies within the triangle determined by these three points; it is therefore presumably the object which Bacon saw. Furthermore, since I did not know at the time that any nebula would be found within the region thus defined, it is probable that those words at least were correctly deciphered. Bacon's attempt to portray the spiral structure of the nebula is also of considerable interest. This spiral structure can at present be detected by photographs only; it is not visible even in the most powerful telescopes. The nebula must therefore have changed considerably in appearance in six hundred and fifty years.[36]

[36] A. S. Eddington, in *Encycl. Brit.*, 11th ed., xix, 332d; art. *Nebula*: " . . The elliptical nebula in Andromeda. Modern photographs show very clearly that its structure is spiral. The nucleus is large and appears circular, but the spirals proceeding from it lie in a plane inclined at a rather sharp angle to the line of sight, and this gives the nebula its elliptical appearance."

Charles A. Young, *Manual of Astronomy* (1909, p. 555:) "It cannot, perhaps, be stated with certainty that sensible changes have occurred in any of the nebulæ since they first began to be observed—the early instruments were so inferior to the modern ones that the earlier drawings cannot be trusted very far; still, some of the differences between them and more recent representations and photographs make it extremely probable that real changes are going on. At present the best authenticated instance of such a change, according to Prof. Holden, is in the so-called 'trifid' nebula in Sagittarius. In this object there is a peculiar three-armed area of darkness which divides the nebula into three lobes. A bright triple star, which in the early part of the century was described and figured by Herschell and other observers as in the *middle* of one of these dark lanes, is now certainly in the edge of the nebula itself. The star does not seem to have moved with reference to the neighboring stars, and it seems, therefore, that the nebula itself must have drifted and changed its form."

As this paper goes to press, Prof. Schlesinger, of the Yale Observatory, sends me the following objection, which I have obtained his permission to print. "The supposed change in the nebula would necessitate movements of its parts in or across the line of sight, or both. If, then, it is distant 300 light-years (and this is the very minimum allowable) it can readily be shown that the outer parts of the nebula must be travelling in the line of sight at a rate of nearly 1000 kilometers per second as compared with the axis of the nebula. If the distance is 100 times greater (and this is more likely), then these relative velocities will be of the order of the speed of light. The supposed motions of portions of the nebula as compared with others across the line of sight would amount in some portions to nearly ten seconds of arc in a year. If such a change as this existed it could easily be detected without measurement, by merely comparing two photographs taken twenty or thirty years apart." As Prof. Schlesinger's objection involves issues which I am not competent to discuss, I can do no more than put it on record for the consideration of astronomers.

(14) Map (from Argelander *Uranographie*) showing the position of the nebula as regards the three points.

(15) A star map with Aldebaran and the Hyades in one sector.

(16) Center, starfish-like object (sun?) from which radiate twelve blue and green "spokes" (sun's influence as modified by the twelve signs ?).

(17) Similar to preceding, but with 28 "spokes" (28 moon-stations ?).

(18) Similar to (11) but with 16 sectors (16 divisions of sky (?) recognized by Etruscan astrologers, described by Martianus Capella, whom Bacon had read).

(19 to (25) Seven of the twelve pages which in the manuscript depict ten of the twelve signs of the zodiac. Central circle with usual symbol of the sign and name of the month; around it two concentric circular bands, representing a lune of the celestial sphere formed by circles drawn through the extreme points of the sign and the poles of the zodiac (*Opus Maius*, i, 259). In the bands numerous human figures, clothed or unclothed, each grasping a star, some partly ensconced in barrel-like objects. These are the souls dwelling in the stars; the "barrels" represent the animal souls from which the spirits are not yet freed (Plato, *Gorgias*, 493A–94B) or the material bodies from which they are not yet entirely disengaged (Plato, *Phaedo*, 81B). The legends attached to the figures always give the name of the person in question (Zenobia, Pericles, Cato the Censor), and in some cases the name of the star in which they dwell. These pages portray Bacon's "Purgatorio" (or "Paradiso"?) a generation before Dante wrote the *Divina Commedia.*

(26) Descent of the souls. Above, a blue and white canopy (heaven?); the nude female figures (souls) plunge feet foremost down a dark channel into a purse-shaped cavity (uterus?).

(27) is too elaborate for description; probably symbolizes multiplication of cells.

(28) Angel proclaiming repentance to mankind (according to the legend).

(29) (Plate II). Upper corners schematized ovaries (nucleated ova); (Fallopian) tubes opened to show stream of ova descending into cavity (uterus), in which are seven souls or spirits (spermatozoa), three not yet awakened to consciousness, four expressing surprise and horror at their environment. Below, eight spermatozoa have discovered a "nest" of eight ova and view their destined dwelling places with expressions of surprise and curiosity, not unmixed with disgust.

(30) Right margin, seminiferous tubes; left margin, ampulla (both from legends); remainder unexplained.

(31) Unexplained.

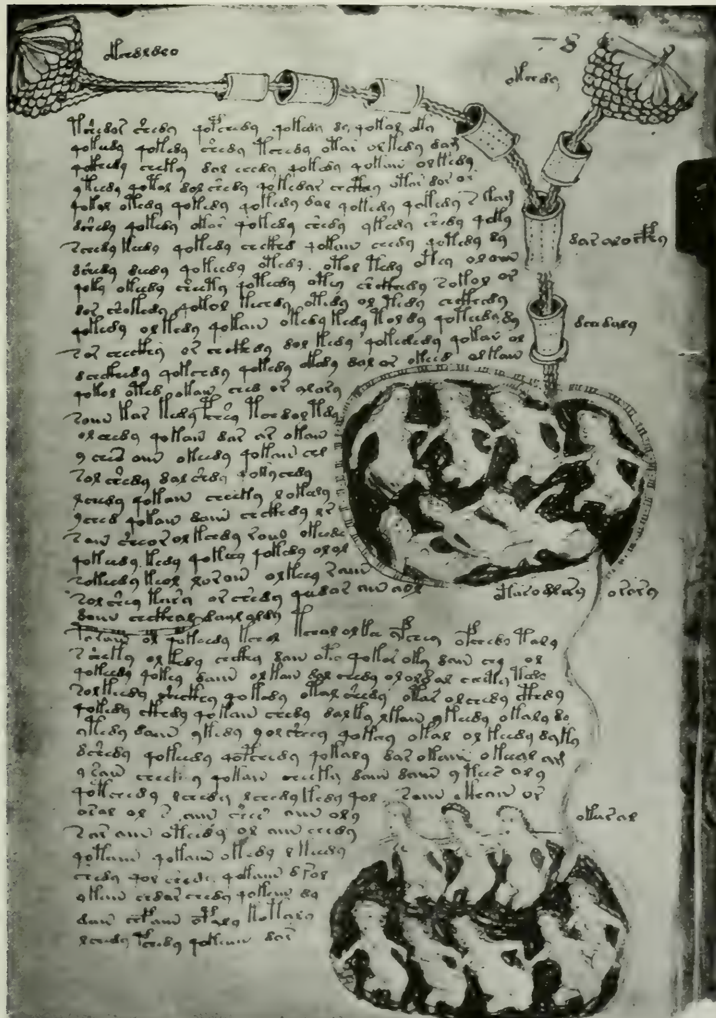


PLATE II.—Newbold.

(32) Left margin (*a*) above, male principle descending in usual form of female figure; (*b*) female principle, perched on cup (cell) looks up expectantly; (*c*) the two in separate "cups" join hands; (*d*) they are united in one "cup"; (*e*) result of the union, the spirit is plunging into green slime (matter).

(33) Left margin (*a*) above, elect soul holds cross (symbol of redemption) in heaven (canopy); (*b*) descends in stupor; foot of page, is partly incorporated into body of scaly monster with other animals near by (subjection of soul to animal passions).

(34) Upper margin, souls bound (by sin) pass crowned figure (the Church) and are freed of their bonds. Middle, bound soul received by the Church into water (of baptism) and emerges free.

(35) Left margin, above, (*a*) triumphant, crowned figure (Church on earth) holds out as a baton distaff-spindle-and-whorl (symbol of universe, Plato *Republic*, 616, D-E); (*b*) diminished in size and deprived of her baton a scaly monster (sin) looks down upon her (gains control over her); (*c*) lower margin, she sinks in matter. Right margin, corresponding symbols of corruption of laity (?).

(36) and (37) Unexplained.

(38) and (39) Too complicated for description and only a few features explicable (?).

(40) Left margin, above, (*a*) figure with long braid (spermatozoön and filament); (*b*) same figure, with hair close-cropped, hands braid, tipped with star, to figure below (spermatozoön and the filament, which contains the astral principle because so motile, are separated in the act of uniting with ovum). Lower left, two figures (the male and female principles) in separate "cups" direct streams each to the other (exchange influences).

(41) Schematized testicles and *membra virilia*.

(43) Plate III (f. 84r) represents one of the most elaborate drawings in the manuscript. Above, the cellular structure of the testicle, the cells of which are blue and white, rains down streams of secretion into a green pool in which the life-principles produced by the gland, symbolized as usual by female figures, disport themselves. On the left margin, half disguised as an element of the design, is an obvious representation of what these little ladies actually look like under the microscope—a spermatozoön. In the middle register, to the left, a similar symbolic figure, presumably representing the soul of the female, has inserted into a cask or barrel (ovum?) a something (life-principle?) and carries another ovum under her arm. On the extreme right the spermatozoa march up in line, hand in hand, to the act of coition, the result of which is to incorporate the spiritual principle in the material body, here represented by the barrel or cask over which the female figure is stooping. The body of this figure also is given a curiously barrel-like contour, not seen in

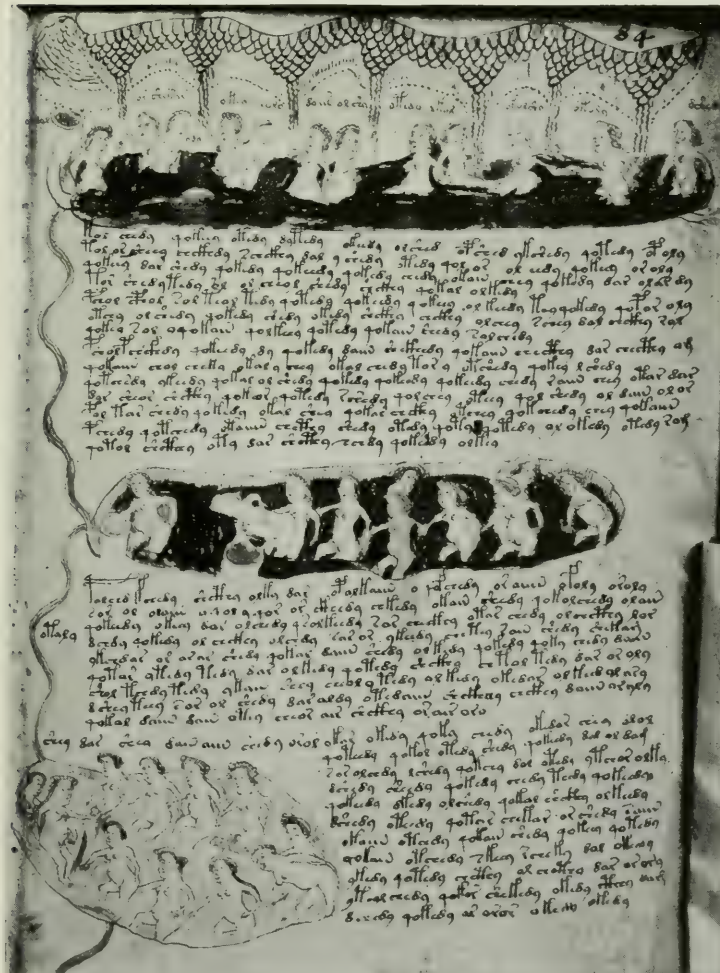


PLATE III.—Newbold.

any other such figure in the manuscript, and the juncture of the neck with the body is drawn in so strange a manner that one can take the left breast as outlining an opening in the top of the barrel out of which is coming the head, neck, left arm and a portion of a snake-like body. This is, I think, intended to symbolize the fact that the spirit introduced in the spermatozoön into the body of the female merely passes through it, so to speak, into its own body, represented by the barrel on the ground.[28]

(45) Two uteri (?) full of souls.

(46) and (47) are strange and elaborate drawings to the meaning of which no clue has been found.

(48) Plate IV represents symbolically the act of coition. At the upper left corner an ovary is depicted as a roe-like mass of ova, of which the greater number have well-defined nuclei. The soul of the female which controls the functioning of the ovary is portrayed as a female figure, of which only the head and one hand are visible, throwing a mass of ova downward. The ovary in the upper right corner has discharged its ova; the dove which flies after them probably represents the brooding influence or control exerted by the soul of the mother over the seed during gestation (*Com. Nat.*, p. 281, 23–26). The scales are immature ova, the more advanced show traces of nuclei. In the two lower corners are two *membra virilia* so schematized as to avoid giving offence; the one on the left throws fine seed upward; the male figure doing likewise is the soul of the male which controls the operation. The one on the left expels three tadpole-like objects, with heads and tails. The parallelism of the drawings puts it beyond doubt that the seed and the tadpole-like objects are alternative representations of the same thing. Bacon therefore knew that the *membrum virile* expels seed possessed of head and tail. The nesting bird attached to the tails represents the soul lodged in the seed, which Bacon compares (*Com. Nat.*, p. 278, 12) to a "son driven out of his father's house and seeking a house for himself." It will be observed that, whereas the ova are without nuclei in the earliest stage of development but have acquired them in the latest, the sperm cells are depicted as originally possessing them but as having lost them at a later stage of development.

(49) Large folding sheet (reduced) bearing nine drawings of circular objects, each possessed of an extraordinarily elaborate internal structure. These drawings were shown severally, Nos. 50 to 58. At two opposite corners of the sheet the sun pours streams of influence (in one case represented by a stream of stars) into the adjacent disks. At the other two corners are objects resembling clock-faces without numerals, one of which pours a stream of influence into the nearest disk. These probably represent the united influences of the other heavenly bodies.

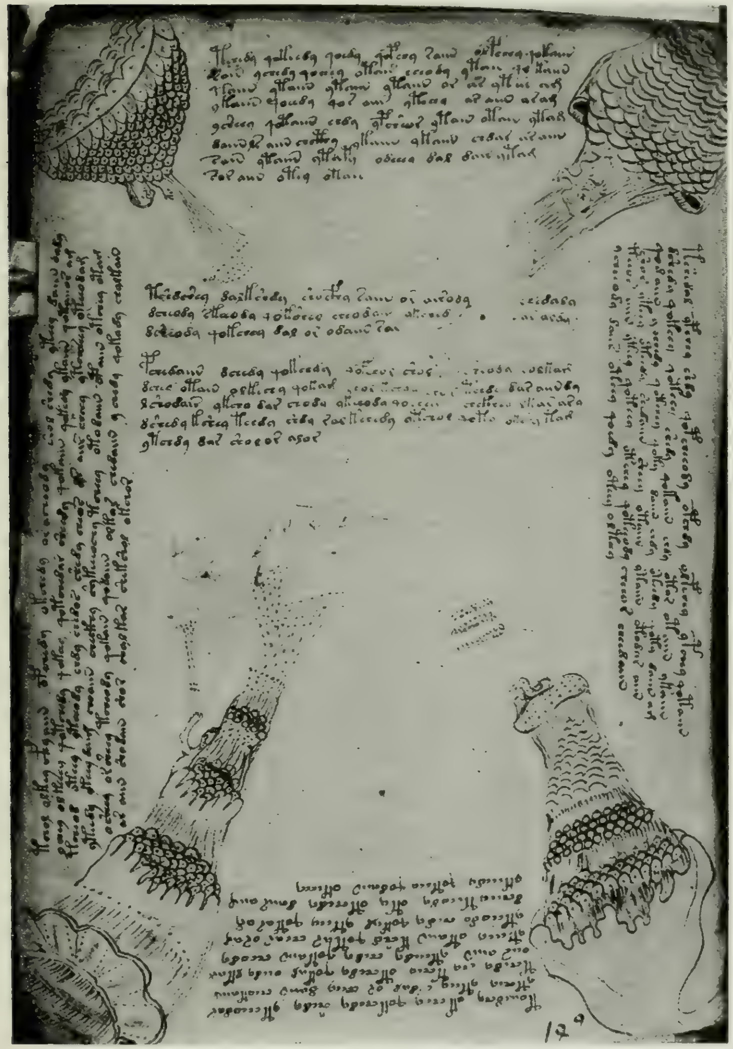


PLATE IV.—Newbold.

(50) Plate V represents one of these drawings. A central oval nucleus is parted by two "blisters" from a ring of cells, which is separated by an open space containing two dotted circles from a second, outermost cell ring.

This and several other of the disks have a marked general resemblance

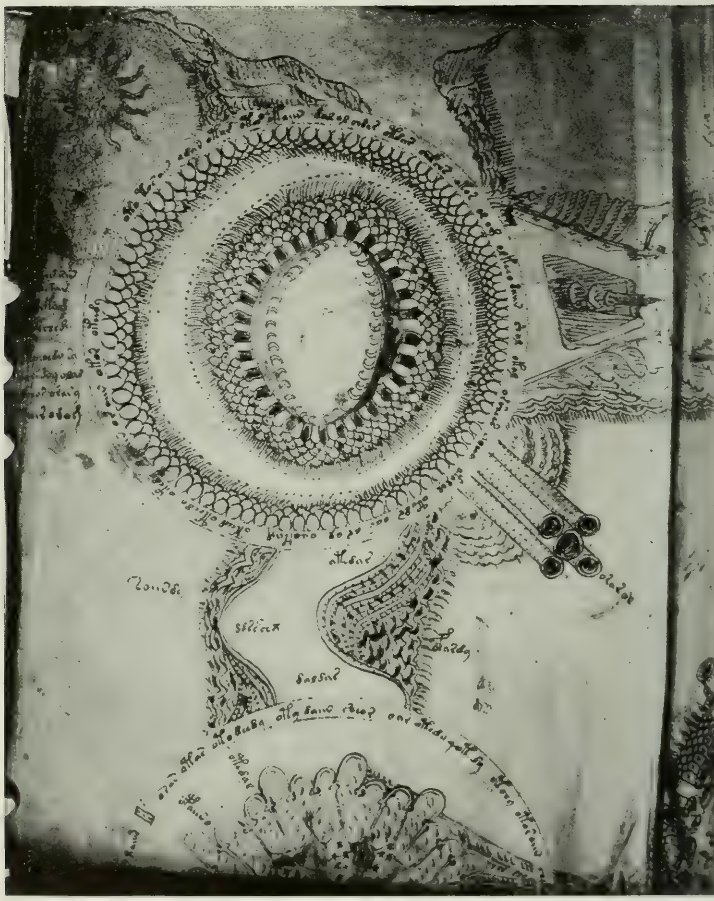


Plate V.—Newbold.

to magnified sections of a fertilized ovum, but the resemblance in detail is not close enough to warrant identifying any one of them with any particular stage of development as seen through modern microscopes. The combination, however, of these anatomical symbols with other

symbols of a different character leaves no doubt that the series as a whole is intended to symbolize Bacon's theory of the development of the ovum, especially of the influences which are brought to bear upon it. Bacon held that six factors are concerned in the generation of the organism: (1) the seed of the female, which supplies the matter, (2) the soul of the male which, operating through (3) the seed and (4) by means of the "spirits," a species of vapor or gas produced by the seed, gives form to that matter, not however without the coöperation of (5) the soul of the female, (6) the united influence of the heavenly bodies, especially the sun, which controls the entire process. All of these factors may be recognized in the drawings. The seed of the female is represented by the cell rings in five of the disks; the male seed by an object resembling the head of a spermatozoön embedded in one of the disks (the same object occurs elsewhere in a context which requires the same interpretation); curious wave-like formations in two of the disks may well symbolize the "spirits." The celestial influence operates from the corners, its effects on the ovum is represented by masses of stars pouring into or massed within the disks, and by pictures of a church, a castle and more modest dwellings inside one of the disks. It is also probably represented by symbols resembling those used in the astronomical section for the divisions of the sky, which are seen within two of the disks. The souls of the parents, which "excrete the seed," are not here represented but are shown on Plate IV.

Especially noteworthy is the fact that this series of drawings expresses the most striking distinction between Bacon's theory and that of Aristotle, namely, the attribution of the dominant control over the process of generation, not to the male seed but to the celestial bodies, especially to the sun.[37]

[37] Arist. *de gen. an.*, i, 22, 730a19: "Among the animals that emit seed, the Nature (or active principle) in the male uses the seed as a tool and as possessing actual motion, just as tools are kept in motion while a thing is being artificially manufactured." *Op cit.*, ii, 5, 741b2: "In case of animals the male of which is distinct from the female, the female cannot of herself bring what she has conceived to completion, for the male would then have had no function, and Nature produces nothing which has no function. In these animals, therefore, it is always the male that completes the generation process, for it implants the sense-consciousness, either of itself or through the semen." Aristotle nowhere attributes to the heavenly bodies any influence whatever, except that he thinks the sun's heat brings into being certain lower forms of life. Bacon's view is very different. *Opera hactenus inedita Rogeri Baconi*, ed. Robert Steele, fasc. ii, *Lib. I*, *Communium Naturalium*, p. 125, 3: "Hence the father is the particular cause of the child, but the sun is the universal cause. And the sun exerts his influence longer than does the father, because the father does not continue the generation until the end as does the sun, but only begins by the excretion of the seed, and the sun causes more dispositions than the father because his action is continued until the end of the process of generation, and therefore his operation is stronger, more ex-

(59) One page from the pharmaceutical section of the manuscript. On the left margin three of the receptacles used by pharmacists for their drugs, resembling in appearance the large glass "bottles" still sometimes seen in pharmacists' windows. Three rows of roots and leaves accompanied by text.

tensive and more violent, not only as regards the existence of the offspring but also as regards the continuation of its existence." Bacon refers to the subject very frequently; see for example, *Op. cit.*, p. 276, 17; 277, 5; 280, 18–26; 281, 7–26; 303, 19 31; 308, 19–26. *Opus Maius*, i, 268, 287, 379–380, 396–397; ii, 546.

SOME EFFECTS OF FAULTY FOOD ON THE ENDOCRINE GLANDS

The Mary Scott Newbold Lecture
Lecture VI[1]

By R. McCARRISON, M.D., D.Sc., LL.D., F.R.C.P.
LT.-COLONEL, INDIAN MEDICAL SERVICE.

Gentlemen, I have to thank you for the honor you have done me, and the Service to which I belong, in inviting me to address you on some phases of my work on deficiency disease and endocrine disorder. I appreciate your kindness the more fully when I consider the unusual conditions of isolation under which my investigations were for the most part carried out. Those of us whose work lies east of Suez must often pay the penalties which isolation entails, and not the least of these is disassociation from intercourse with one's fellow-workers. It is therefore with a vivid consciousness of my own shortcomings—both inherent and environmental—that I lay before you this evening certain results of my labors during the last few years.

I propose to demonstrate, with the aid of lantern slides, some effects of faulty food on the endocrine glands. My observations have been confined mainly to a study of the effects on these (endocrine) organs of (*a*) inanition, (*b*) vitamin deficiency in association with ill-balance of the food, and (*c*) fat excess in relation to the thyroid gland. Since my results falling under the first two of these headings have already been published, I propose to refer to them more briefly and to devote most of the time at my disposal

[1]Read November 11, 1921

to an account of more recent work on the subject of fat excess in relation to the thyroid gland.

Inanition. Inanition gives rise to enlargement of the adrenal glands and to atrophy of all other endocrine structures. The atrophy of the thyroid is considerable and amounts to almost one-third of the normal weight of the organ. In pigeons starved to death the thyroids weigh 59 mg. per kilogram of original body weight as compared with 86 mg. in healthy controls. The adrenal glands increase in weight by approximately two-fifths of their normal weight. In control pigeons these organs weigh 95 mg. per kilogram of body weight; in starved animals they average 125 mg. per kilogram of the original body weight of the animals. The enlargement is associated with an increase in their content of medullary secretion—epinephrin—as determined by kymographic observations in sheep.

This observation as to the effect of inanition on the adrenal glands has been confirmed by Vincent and Hollenburg not only as regards pigeons but also in rats and dogs. In dogs after a somewhat longer period of inanition than fifteen days the adrenal bodies are almost double the normal weight. In rats the hypertrophy is considerably greater than in pigeons and dogs even when inanition is less protracted.

Turning now to *the effects of deficiency of vitamins*, we find changes in the endocrine organs similar to those resulting from inanition: (1) There is the same atrophy of the thyroid, the gonads and the pancreas, and (2) the same hypertrophy of the adrenal glands, while (3) an increase in weight of the pituitary body occurs in males only. These results have been observed in all animals, irrespective of species, so far used for experimental purposes. In pigeons they occur alike under conditions of complete avitaminosis and of deprivation of vitamin B only. In monkeys, on the other hand, while the adrenal enlargement occurs in all forms of vitamin-starvation and the pituitary enlargement in most forms, the latter was not observed to result from a well-balanced diet of autoclaved food, butter, and onion, in which both vitamins A and C were present in abundance, but from which vitamin B was absent.

These effects on the endocrine organs were observed in pigeons fed on "rice polishings," that is to say, on a diet rich in vitamins but deficient in proteins and calories. In these circumstances, however, the thyroid was but little altered in weight while the atrophy of the pancreas was more marked than in the previous cases and the atrophy of the gonads less so. There was also, in the limited number of pigeons I used for this observation, no appreciable increase in size of the pituitary body, while hypertrophy of the adrenal glands was approximately the same as that resulting from a diet deficient in all classes of vitamins.

In general terms, then, it may be stated that malnutrition, whether arising from complete starvation, from the incomplete starvation due to avitaminosis or from starvation resulting from deficiency of proteins and calories, gives rise to *an enlargement of the adrenal glands and sometimes of the pituitary body, with an atrophy of all other endocrine structures.*

The Character of the Adrenal Enlargement Varies with the Character of the Vitamin Starvation: 1. In guinea-pigs a diet deficient in vitamin C causes a great reduction in the epinephrin-content of the enlarged adrenals; the enlargement is associated with degenerative and hemorrhagic changes, the latter being mainly confined to the cortex. These changes are apparent in the glands before clinical evidences of scurvy are manifest. Indeed, functional impairment of the suprarenal bodies is one of the earliest, as well as one of the most pre-eminent, of the pathologic features of experimentally produced scurvy. These observations have been confirmed in this country by the work of La Mer and Campbell, who have further found that the increase in weight of the suprarenal glands is directly proportional to the time during which the animals have been fed on the scorbutic diet. It is most pronounced in those whose life has been prolonged by the partial protection afforded by small but insufficient quantities of tomato juice. It follows, therefore, that impairment of adrenal function is one of the earliest results of a deficiency in the food of fresh fruit and green vegetables.

2. The enlargement of the adrenals resulting from complete

avitaminosis tends to be less marked when the deficient food is more perfectly balanced with respect to proximate principles and to be more marked when it is disproportionately rich in energy-bearing constituents. It is associated in pigeons, rats and monkeys with an increase in the epinephrin-content of the organs approximately proportionate to their increase in size and with an almost complete absence of lipoids from the cortex. Histologically there is in pigeons a preponderance of cortical over medullary columns of the gland. Indeed, the enlargement is to a considerable extent the result of hypertrophic changes in the cortex of the organ, although the medullary cells also lengthen. The depletion of cortical lipoids is, according to the more recent work of Cramer, dependent upon the absence of vitamin A. With deficiency of vitamin B alone this severe depletion does not occur, although the distribution of lipoids in the adrenal cortex becomes irregular. Coincident with the saving of lipoids in the adrenal cortex affected by the presence of vitamin A in the food, one finds, in the case of pigeons deprived of vitamin B, but receiving in butter an abundance of vitamin A, that although the enlargement of the adrenal gland is just as great there is no increase, as a rule, in the epinephrin-content of the organ; on the contrary, its content of this substance is not increased in proportion to the increase in size of the gland; but it is relatively diminished. The excess of fats in the deficient dietary of pigeons leads to congestive changes in the medullary columns of the adrenal. This congestion is present whether the fat used be butter or cocoanut oil and is related, therefore, to the effects of fat-excess in association with the deficiency of vitamins B and C rather than to the presence or absence of vitamin A in the food. Associated with these changes in the adrenals there may be present degeneration of their sympathetic ganglia.

It is evident from all these facts that the functional perfection of the adrenal glands is dependent upon the balance of the food and the quantity and quality of its vitamins, and that an intimate relation exists between the adrenal glands and the metabolic processes of the animal organism.

Fat Excess in Relation to the Thyroid Gland. We come now to a consideration of the effects of fat excess on the thyroid gland.

If semi-wild pigeons be fed on a liberal diet of mixed grains, including an excess of butter, then the thyroid gland undergoes enlargement in a high proportion of cases (approximately 65 per cent) while the adrenal glands are smaller than normal—a dual effect which, it will be noted, is the reverse of that produced by food deficiency.

If onions be added to the diet of mixed grains and butter then the incidence of thyroid enlargement is not so high (33 per cent), the enlargement is moreover not so great, nor are the adrenal glands so small as in the absence of onions.

The experiments which gave these results were as follows:

1. Eighteen semi-wild pigeons were confined in a large netted wire cage, 5 ft. by 3 ft. by 2 ft. They were fed on a mixture of grains consisting of white millet seeds 12 oz., small dark millet seeds—known in India as *ragi*—8 oz., and split peas, of the variety known in that country as *mungdal*, 8 oz. Three ounces of fresh butter were intimately mixed by hand with the grains. The birds received this mixture daily. No sand or grit was provided.

2. Eighteen other semi-wild pigeons were similarly confined and fed on the same mixture of seeds and butter, but with the addition to it of a daily allowance of 6½ oz. of freshly chopped onions. These also received neither sand nor grit.

3. Forty-two pigeons similarly confined and fed on millet seeds only, without the addition of butter, onions or sand, acted as controls to the experiment.

In all three cases water was supplied in shallow troughs suspended a few inches above the bottoms of the cages.

The experiment was carried out at Coonoor, Nilgiri Hills, Madras—6000 feet above sea-level—where goiter is practically unknown. It lasted 248 to 250 days; at the end of this period the birds that had survived were killed—several had died in consequence of maltreatment by their fellows.

It was found that:

1. The average weight of the thyroids per kilogram of body weight was 82 mg. in birds receiving mixed millet seed only; in those which received mixed grains with butter and onions it was 128 mg.; and in those which received mixed grains with butter only, 183 mg.

2. Of fifteen pigeons which received *butter and onions* the weight of both thyroids exceeded the maximum weight in controls in five cases. Goiter was present in $33\frac{1}{3}$ per cent and absent in $66\frac{2}{3}$ per cent of cases.

3. Of seventeen pigeons which received *butter without onions* the weight of both thyroids exceeded the maximum weight in controls in eleven cases. Goiter was present in 65 per cent and absent in 35 per cent of cases.

4. On histologic examination the enlarged thyroids of pigeons that received *butter and onions* presented a picture showing moderate congestion with the formation of many new acini whose epithelium did not exceed in height, or but slightly, that of the normal actively secreting gland. There was slight tendency to acinar budding. Colloid was comparatively scanty, thin and pale-staining. Multiplication of acini was the essential feature of this type (Fig. 3).

5. On histologic examination the enlarged thyroids of pigeons that received *butter without onions* presented a picture showing little or no colloid, increase in height of the acinar epithelium, pronounced vesicular budding, irregularity in shape of the acini and plications of their walls—a picture similar to that characteristic of Graves's disease. Hypertrophy of acinar epithelium was the essential feature of this type of goiter (Fig. 2).

The excessive richness of the food in butter was in this experiment a determining factor in the production of the thyroid hyperplasia and of the pronounced acinar budding.

A no less noteworthy result was the protective influence exerted by the onions. The addition of this vegetable to the diet of mixed grains and butter tended to lower the incidence of goiter, to reduce the average size of the thyroid enlargement, to restrain the inten-

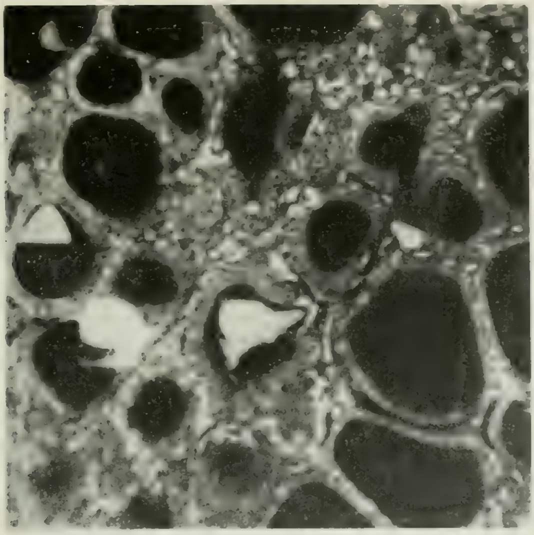


FIG. 1.—Section of normally sized thyroid gland of healthy control pigeon fed on mixed grains. × 265.

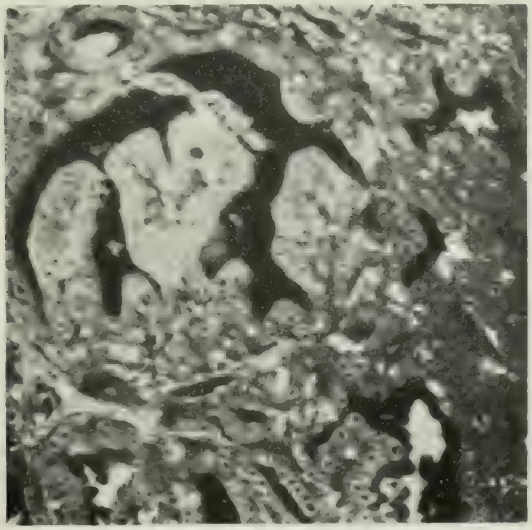


FIG. 2.—Section of goiterous thyroid gland of pigeon fed on mixed grains *and butter*. Note intense hyperplasia and acinar budding. Hypertrophy of epithelium is the characteristic feature of this type. × 265.

sity of the hyperplasia and the tendency to acinar budding, and to alter the character of the histologic picture from a hypertrophic type to one characterized by acinar multiplication. Variations in the histologic types of goiter may thus be brought about by variations in the components of a goiter-inducing food.

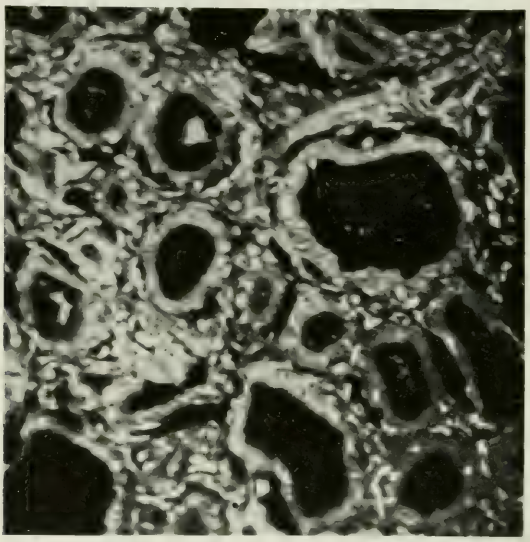


FIG. 3.—Section of goiterous thyroid gland of pigeon fed on mixed grains, *butter and onions*. Note effect of onions in restraining the thyroid hyperplasia and in limiting the acinar budding. Multiplication of acini is the characteristic feature of this type. × 265.

It will have been noticed that in pigeons fed on mixed grains and butter, but without onions, the incidence of goiter was 65 per cent. In the remaining 35 per cent there was no goiter, and judged by two samples taken from the minority, there was no appreciable departure of the thyroid gland from normal. Under one of the microscopes a specimen has been placed which shows in the upper hemisphere of the field the thyroid hyperplasia that resulted in one pigeon from a diet excessively rich in butter, and in the lower hemisphere the practically normal appearance that was retained by the thyroid of another despite the same excess.

The cases that did not develop thyroid hyperplasia have a significance second only in importance to those that did. They suggest that the excess of butter was not in itself the cause of the thyroid enlargement, but that it was made a potent contributing or determining cause by the operation of another factor or factors. My previous work had indicated the important part played by bacteria introduced into the digestive tract in the causation of goiter; in contributing to the results of this experiment the possible intervention of a bacterial factor should therefore be considered. The restriction of such bacterial intervention would afford an explanation of the protective influence exercised by onions in restraining the thyroid hyperplasia, for it seems unlikely, that a sufficient explanation is to be found in an increased iodin intake consequent on the addition of onions to the dietary. I think it well to insist on this probability of bacterial intervention, for my recent work on "Deficiency Disease" has impressed upon me the necessity for bearing in mind not only the conditions of faulty food to which animals or man may be subjected, but also the variable character of the bacterial flora with which the faulty food may be associated in the digestive tract. Here we are concerned with faulty food in relation to goiter-production; in relation, that is to say, to a malady whose prevention is dependent on the provision of an adequate supply of iodin for the needs of the thyroid. It is necessary, therefore, to take account of every means by which this supply may be interfered with.

So much, then, for my original observation in regard to the effects of a diet excessively rich in butter in contributing to the production of thyroid hyperplasia of the Graves's disease type. It is hardly necessary to remind you that this hyperplasia did not involve the discharge from the gland of an amount of thyroid secretion in excess of the requirements of the tissue cells. The pigeons presenting the thyroid hyperplasia of the Graves's disease type did not exhibit any other signs of Graves's disease. The resemblance to this malady ended with the identity of the histologic picture of the thyroid gland in the two cases.

This observation as to the part played by food excessively rich

in butter in producing hypertrophic goiter has recently received confirmation from the work of E. and M. Mellanby, who have reported similar results in puppies. They found that of the fats used by them butter induced the greatest degree of hyperplasia; other edible fats were less noxious in this regard. They found, moreover, that cod-liver oil did not produce thyroid hyperplasia and attributed this protective action to the oil's content of iodin. They comment also on the fact that the thyroid enlargement tended to be less marked when the fat-fed puppies had ample opportunity for exercise and an outdoor life.

In pursuance of my original observation and of the more recent results of the Mellanbys, I devised an experiment to contrast the action on the thyroid gland of *free oleic acid* with that of *butter* and of *cod-liver oil*. It is necessary to refer in some detail to the conditions under which this experiment was carried out, since these proved to be highly goiter-producing. A small shelter, six feet square and open at one side, was built on the roof of the laboratory at Oxford. In contrast to Coonoor, where the first experiment was carried out, goiter is common in Oxford. A number of small netted wire cages, approximately sixteen inches square and having a netted-wire bottom, beneath which was a removable zinc tray, were placed in this shelter. The cages were piled one on top of another in columns of three. Two pigeons were placed in each cage. The amount of movement permissible to the birds was thus more limited than in the first experiment, and the hygienic conditions were still less perfect. The conditions under which the birds lived were, in short, highly favorable to the production of goiter, as the results noted in control birds at the conclusion of the experiment show. Some of the pigeons used were highly bred casters from among show birds, descended from a stock that had always lived a confined life; the tendency to goiter-production was thus enhanced by hereditary factors. Twenty-eight birds were employed in the experiment, which commenced on April 4 of the present year and terminated on August 26—having been continued for a period of 144 days. The birds were fed on a shop-mixture of buckwheat, wheat, split-peas, barley, maize, and white African

maize. Each bird consumed of this mixture approximately 50 grams per day. Six were in addition given 1.6 cc of oleic acid per bird per diem in admixture with their grains; 6 received 4 grams of butter per bird per diem; and 6 received 1 dram (3.55 cc) of cod-liver oil per bird per diem in admixture with their grains. It was noted that the birds ingested the major part of the several fats given. The cod-liver oil was the so-called "cattle cod-liver oil" and contained 0.002 per cent of iodin. Six birds acted as controls; these received the same grains, in the same proportion,

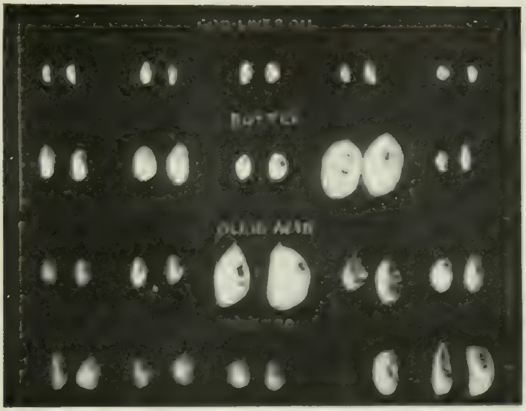


FIG. 4.—Showing the effect of *butter* and of *oleic acid* in accentuating the goitrous process induced by overfeeding, confinement, lack of exercise and contamination of the food by the birds' excreta. Note also the effect of cod-liver oil in counteracting these goiter-producing influences.

but no fats. They were confined in the same way (two to a cage) and in the same shelter as the birds receiving fats. One bird from each batch was killed during the course of the experiment in order to ascertain how the experiment was proceeding. The remainder were killed on the 143d to 144th days; their thyroids and other organs were removed and weighed and the former photographed life-size (Fig. 4). It was found that (1) goiter, sometimes of large size, was present in controls, in those which received butter and in those which received oleic acid, but was not present in those which received cod-liver oil. (2) The incidence of goiter was as high

in controls as in birds that received butter or oleic acid. (3) The average weight of the thyroids per kilogram of body weight was, however, different. It was:

In controls	537 mg.
In butter-fed pigeons	675 mg.
In oleic-acid-fed pigeons	909 mg.
In cod-liver-oil-fed pigeons	93 mg.

(4) Great variation in size of the goiters in the first three categories was a notable feature.

The outstanding results of this experiment are: (1) The potency of the conditions of close confinement, want of exercise, overfeeding and fecal contamination of the food in causing goiter. (2) The completeness of the protection against goiter afforded by cod-liver oil. (3) The influence of butter in favoring the development of the thyroid swelling and the still greater influence of free oleic acid in so favoring it. (4) The pronounced individual idiosyncrasy to the disease, as evidenced by the size of the goiters. The last feature is one to which I have drawn attention in the case of goiter produced in kids and in rats by means of cultures of fecal bacteria from goiterous persons. It suggests the possible influence of individual variations in metabolism in determining the size of the goiter, the greater need of some individuals for iodin than of others or the more potent operation in some cases than in others of bacterial agencies in the digestive tract in hampering the absorption of iodin. The fact that free oleic acid appears to be more potent in favoring goiter-producing than butter suggests that it may be by means of the free unsaturated fatty acid derived from butter in the digestive tract that the latter exerts its harmful action on the thyroid gland.

The two main facts brought into prominence by this second experiment, namely, that the free unsaturated fatty acid—oleic acid—is peculiarly potent in respect to goiter-production, and that cod-liver oil containing 0.002 per cent of iodin is peculiarly beneficial in respect to goiter-prevention, both point to iodin as a common factor concerned in these results: It would seem that in the

presence of an excess of free oleic acid the iodin in the food is in certain cases either rendered unavailable for use by the thyroid gland or a larger amount of iodin is in these circumstances required by the thyroid gland. Or that the absorption of oleic acid in excess creates in certain cases an increased demand for thyroid secretion on the part of the tissues. In the presence of an excess of cod-liver oil, on the other hand, it would appear that a supply of iodin sufficient to resist goiter-producing influences of a high degree of intensity is provided by the oil. Further experimental evidence is available relative to these views.

While the second experiment was proceeding others were in progress with the object of studying the relation between fat-excess and iodin-intake. For this purpose tadpoles were used. It was thought that their sensitiveness to the influence of iodin might serve as an index of the harmful effect exerted by fat-excess on the thyroid gland. The experiments yielded remarkable results. The tadpoles used were of the same age—eleven days—and approximately the same size. Fifty were used for each test. They were kept in white pudding dishes, each containing one liter of tap water; great pains were taken to keep the dishes clean and the water fresh. They were fed on a mixture of flour 85 parts and caseinogen 15 parts, with green pond-weed q. s. The flour-caseinogen mixture was made into a soft dough with water, and pills of it were dropped into the dishes. These the tadpoles ate greedily. Cannibalism was very rare. Among the fats tested were butter, oleic acid and cod-liver oil. The several fats were mixed with the flour-caseinogen mixture in the proportion of approximately one part of fat to two of the mixture. The addition of the fat enabled small pills to be prepared as above-mentioned. These also the tadpoles ate greedily during the earlier part of the experiment, more sparingly during its later stage. Three series of experiments were carried out. In the first the effects on the developing tadpoles of the several fats were observed in contrast with controls receiving the same food without fats; in the second the effects of the several fats, with the addition of 0.5 mg. of iodin per gram of food-mixture, were observed in contrast with controls receiving the same amount

of iodin but no fats; and in the third the effects of the several fats, with the addition of 1 mg. of iodin per gram of food-mixture, were observed in contrast with controls receiving the same amount of iodin but no fats. Details of the experiments as they proceeded have recently been published in the *Proceedings of the Royal Society*. The results reached were as follows:

1. An excess in the food of tadpoles of the several fats caused remarkable retardation in their rate of growth (Fig. 5).

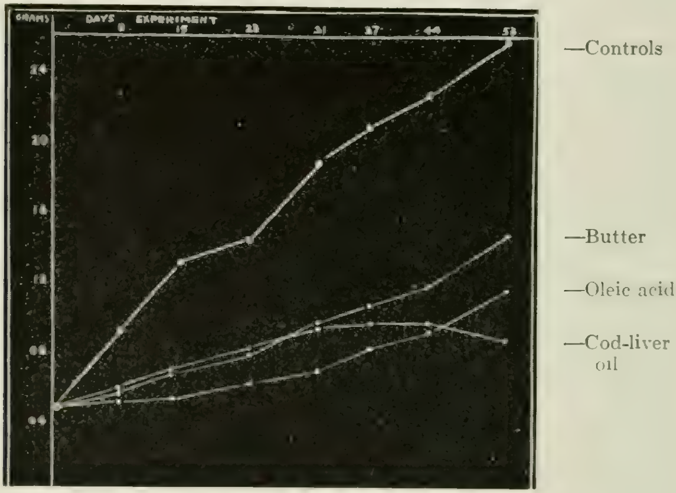


FIG. 5.—Chart showing effect of *butter, oleic acid* and *cod-liver oil* in retarding the growth of tadpoles.

2. Iodin in amounts of 0.5 to 1 mg. per gram of food-mixture tended to prevent the retardation of growth induced by butter and oleic acid, but did not prevent that induced by cod-liver oil (Figs. 6–9).

3. The compensating action of iodin varied in the case of the several fats: it was complete in the case of oleic acid (Fig. 7); almost so in the case of butter (Fig. 8).

4. So far from iodin exercising any compensating action on the retardation of growth induced by cod-liver oil, this retardation was further accentuated by the iodin (Fig. 9).

5. The normal rate of metamorphosis was but slightly affected by the harder fats, such as butter, but was delayed by the fluid and less saturated fats: oleic acid and cod-liver oil.

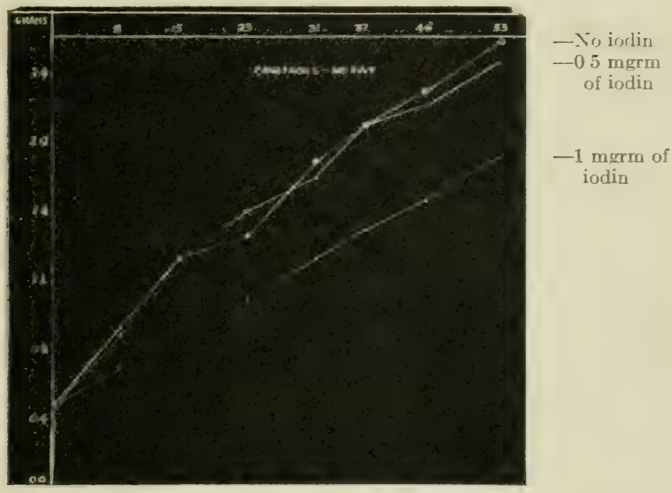


FIG. 6.—Chart showing effect of iodin on the growth curve of tadpoles.

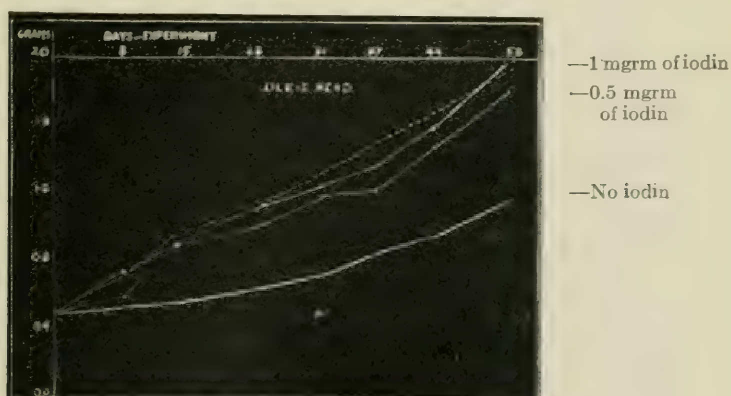


FIG. 7.—Chart showing effect of iodin in compensating for the retardation of growth induced in tadpoles by *oleic acid*. Dotted line shows normal growth rate in tadpoles receiving iodin but no oleic acid.

6. The delayed rate of metamorphosis induced by oleic acid was compensated for by the presence of 1 mg. of iodin per gram of food-mixture, but was not compensated for by this amount of iodin in the case of cod-liver oil.

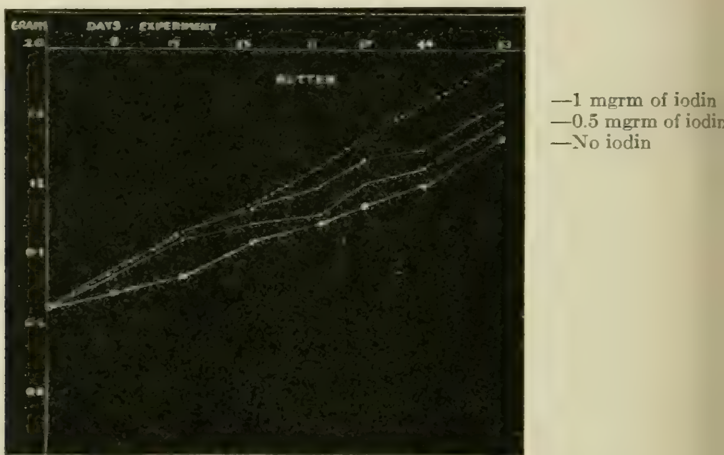


FIG. 8.—Chart showing effect of iodin in compensating for the retardation of growth induced in tadpoles by *butter*. Dotted line shows normal growth rate in tadpoles receiving iodin but no butter.

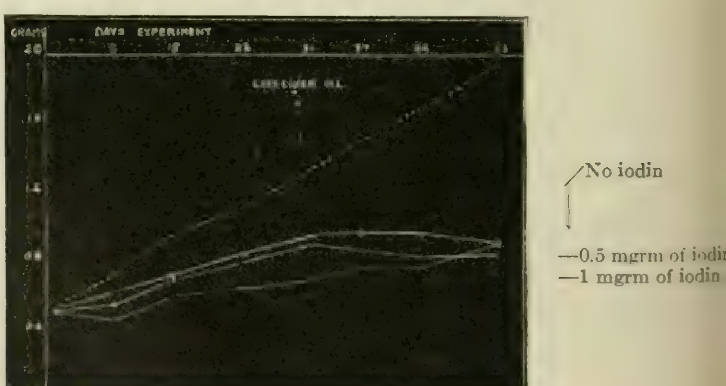


FIG. 9.—Chart showing effect of iodin in further accentuating the retardation of growth induced in tadpoles by *cod-liver oil*. Dotted line shows the normal growth rate in tadpoles receiving iodin but no cod-liver oil.

7. The retardation of growth induced by the fats was associated with delayed development of the thyroid gland. Iodin in the above proportion compensated for the retardation of thyroid development induced by butter and oleic acid, but did not compensate for that induced by cod-liver oil.

8. Finally, in a further experiment, in which tadpoles were fed on flour-caseinogen mixture 100 parts and metallic iodin 1 part, the abnormally rapid metamorphosis induced by the high iodin intake was considerably hastened by a high proportion of butter in the food-mixture, but was markedly delayed by a similar proportion of cod-liver oil in the food-mixture.

From these results the general conclusion may be drawn that in so far as butter and oleic acid are concerned an intake of iodin approximately proportionate to the intake of these fats in the food is requisite for the maintenance of normal metabolism and for the normal functional perfection of the thyroid gland. The influence of iodin in further retarding bodily growth and development of the thyroid gland in the case of cod-liver oil, when administered in dosage favorable to both in the case of butter and oleic acid, is not yet understood. It is to be noted, however, that this effect of iodin was the more marked the larger the dose of this element (Fig. 9). A further contrast in the behavior of butter and cod-liver oil is afforded by their action in the presence of a high iodin intake by tadpoles. The abnormally rapid metamorphosis induced by the iodin was hastened by a high proportion of butter in their food, but was delayed by a similar proportion of cod-liver oil. While it is not yet possible to afford a complete explanation of these reverse effects of butter and cod-liver oil, the facts as they stand indicate an important relationship between thyroid function and the metabolism of iodin and fats. Free oleic acid and cod-liver oil have, in respect to their relations with the thyroid gland, reverse effects; the former favors thyroid hyperplasia, the latter protects against it. In respect to iodin they seem also to have reverse relations: the former when ingested in excess requires to be combined with iodin in the approximate proportion of one part of this element to 3000 of the unsaturated fat, in order that it may

be rendered harmless to tadpoles; the latter when ingested in excess by tadpoles becomes more harmful if combined with this amount of iodin.

Oleic acid also seems to exercise an effect on the thyroid gland of tadpoles which has not been observed in the case of cod-liver oil, nor in the same degree in the case of butter. It would appear, from the limited number of observations I have so far made, to cause a diminution of the colloid-content of the gland out of proportion to its retardation in development.

The results of the experiments indicate that there is such a thing as a "fat-thyroid-iodin balance," and that this balance may be disturbed either by an intake of iodin insufficient for the needs of the body in the particular circumstances in which it finds itself or by the presence in the digestive tract of an excess of fat and more especially of an excess of free unsaturated oleic acid. Goiter may arise, therefore, either from actual deficiency of iodin or from relative deficiency of iodin. We thus have an example of a deficiency disease (goiter)—due to an insufficient supply of one essential element of the food (iodin)—arising in consequence of or favored in its development by excess of another essential element of the food (fat). It has become usual of late to read of "relative deficiency of iodin in the food" as though the conditions under which it may arise had been known. The present results indicate one means by which such relative deficiency may be brought about, namely, by an excess of edible fat or of free oleic acid in the digestive tract.

Deficiencies in Combination with Excesses. Let me conclude now with an example of the effects on the thyroparathyroid glands of a combination of deficiencies and excesses: In the course of my studies on the pathogenesis of deficiency disease I had occasion to feed wild monkeys (*Macacus sinicus*) on a diet composed of autoclaved rice and butter. This diet is deficient in vitamins B and C and in proteins and salts; it is also disproportionately rich in fats and starch. It gave rise to notable changes in the thyroparathyroid glands, namely, to a combination of atrophy with congestion. The average weight of the thyroid was 73 mg. per

kilogram of original body weight as compared with 83 mg. in controls. On section the glands were found to be of the colloid type. In all cases the periacinar capillaries were much distended, each acinus being sharply outlined in whole or part of its circumference by a capillary envelope of pink-staining blood corpuscles. In the three cases in which the parathyroids were found on section they were much congested, and in one case hemorrhagic infiltration had caused disruption of the compact mass of polygonal cells composing the glandule. I have on only one other occasion encountered similar changes in parathyroids under experimental conditions, namely, in newborn rats whose mothers were fed throughout pregnancy on anaërobic broth cultures of fecal bacteria. It seems not unlikely that the hemorrhagic changes in the parathyroids were in both instances due to like toxic substances. In the former case these were permitted to exert their deleterious influence owing to the changes in the intestinal mucosa and liver which result from the deficient food. In the latter their massive dosage acted through the medium of the maternal blood. However this may be, it is important to realize that a food presenting the faults of deficiency on the one hand and excess on the other, to which reference has been made above, may give rise to parathyroid changes in monkeys; an observation which may have an important bearing on the genesis of infantile tetany.

This mention of the noxious action of bacteria or of their products on the thyroid gland calls to mind one of the most important of the effects of deficient and ill-balanced food on this organ. The faulty food permits of the entry into the blood stream of intestinal bacteria which, acting on the thyroid, may cause congestion of the organ, desquamation of its acinar cells and distortion of its normal acinar structure. Indeed, it is possible by examination of the thyroid alone, with but a small percentage of error, to distinguish between those deficiently-fed animals that have suffered from septicemic states in consequences of the food fault and those that have not.

I trust that the results I have placed before you will serve as sufficient example of the profound disturbances of endocrine func-

tion that may be brought about by faulty food. They provide not only evidence of an important means whereby these organs are disturbed in the performance of their normal function, but afford, also, a clearer insight into the nature of this function. It is a step in advance to be aware that an insufficient consumption of protein or of vitamins or the insufficient inclusion of fresh fruit and leafy vegetables in the dietary tends to impair the functional capacity of the adrenal glands; that an intimate relation exists between these organs and the metabolic processes of the animal organism; that in the maintenance of metabolic harmony much depends on the balance of power which perfectly constituted food sustains between the thyroid gland and the adrenal bodies; that an excess of edible fats in the food may, in certain circumstances, involve a relative deficiency of iodin and an undue stimulation of the thyroid gland; and that the unsaturated fatty acid (oleic acid) is peculiarly harmful in this regard.

AN ANACHRONISM OF THE TWENTIETH CENTURY THE MIDWIFE

The Nathan Lewis Hatfield Lecture

Lecture III[1]

BY WILLIAM R. NICHOLSON, M.D.

It is eminently fitting—but more than that, it is indispensable to the continuity of the argument which I shall present—that before proceeding with the subject-matter of my address before you tonight I should offer an apology, in the good old meaning of that term, for my presence at this time and place. If I had nothing constructive to offer as a solution of the problem suggested by the title of my paper, it would ill befit me to ask the attention of an audience, unless composed alone of medical historians to whom the former activities of the midwife are of interest, or of coroner's deputies to whom the present-day midwife is important. Such is not the case, however. I have something which I believe is an important advance in the method of meeting and handling this question, and I am of the opinion that the statistics which I shall lay before you, while admittedly incomplete, are nevertheless convincing as to the truth of the conclusions which I hope to establish, namely, that under present-day conditions in this country the midwife is an indispensable factor in the management of childbirth among the poor, and that here in Pennsylvania, acting under the authority of the Bureau of Medical Education of the state, we have proved that it is possible to control and educate her to a degree never before attained in this country.

A midwife is a woman who, habitually and for gain, attends cases of childbirth without the assistance of a medical practitioner, except in grave emergencies. I desire emphatically to call your attention to the fact that, in by far the greater number of com-

[1] Read February 18, 1921

munities, her work is legalized, and that in the relatively small number of civilized communities which do not thus legalize her, she does not renounce her profession but simply does her work clandestinely. While to some of my audience the present-day activities of the midwife may be common knowledge, experience has shown me that the majority both within and without the medical profession are entirely ignorant upon the subject. Indeed, many seem to think that Shiprah and Puah, the midwives of the book of Genesis, who withstood Pharaoh and saved the babies of Israel alive, were the last of their profession; therefore, for the sake of those who have not kept up with the midwife of modern times, I will ask indulgence while I portray certain elementary though possibly interesting and certainly important facts concerning her.

First of all, it is to be remembered that as an institution she is an heritage from the remote past of the human race. Before history was born her sisterhood was doing the work which it does today, and, unfortunately, in communities which have not established control over the activities of the midwife, her methods have not changed materially during the ages. Her armamentarium in bygone times consisted in relics, charms and incantations, as is shown by the injunction made by the celebrated Bishop Bonner, in 1554, that "A midwife shall not use or exercise any witchcraft, charms, sorceries, invocations or prayers other than such as be allowable and may stand with the laws and ordinances of the Catholic Church." During the period in which our own profession received its authorization to practice from the Church, the midwife received hers from the same source, and it is interesting to note that it was only when the state took up the matter of the legalization of the medical profession, that, with an inexcusable lack of foresight, the status of the midwife was allowed to lapse, with the result of untold misery. Here, of course, I simply refer to the English midwife, as space forbids any allusion to her still more interesting Continental sister. The midwife of England was licensed by the Church from the time of Bishop Bonner until 1642, from which date for a period of twenty years this responsibility rested upon the Chirurgions' Hall; then, in 1662, the Act of Uni-

formity sent the midwives to Doctors' Commons, where in the words of Elizabeth Cellier, a noted midwife of the period and withal a woman of decided intelligence and force, "they pay their money (take an oath which it was impossible for them to keep) and return home as skilful as when they went thither." This was a decided retrograde step, since certainly there can be no question that it were better to exercise some control over midwives, even if conducted by the Church to the end of baptism alone, than to relieve them of all oversight.

Of course, readers of English literature know something of the midwife as she is portrayed by various authors, since she makes rather frequent appearance in the works of the older writers; but I would emphasize that, while in certain of the relatively recent classics of the English-speaking world she is held up to derision, she was for centuries a person of influence in her community and one to be most seriously reckoned with. From the time of Hippocrates until the Seventeenth Century she was the obstetrical arbiter of the world. She and she alone held the secrets of the lying-in room. Not only did she deliver the nations of the world, but their rulers as well. The list of royal midwives is a long one, and her responsibility even in these cases was absolute, until the time of George IV, at whose birth, while Mrs. Stevens was in sole charge, William Hunter was held in reserve in a neighboring room, where, it may be remarked, he remained. Hunter's presence nearby was in deference to the change in opinion which, under French influence, was then becoming manifest. As late as 1819, Queen Victoria was ushered into the world by a midwife specially imported from Germany for the event, because of a tragedy a short time previously occurring in physicians' hands, in which both the royal patients died soon after the delivery had been completed.

What knowledge the ancient midwife possessed may be judged by remembering that the earliest book placed in her hands was the translation of Rhodions' *De Partu Hominis*, done into English by Richard Jonas in the year 1540, as he expressly states in his preface "at the request and desire of divers honest and sad matrons being of his acquaintance." If she was of a slightly later generation,

the *De Conceptu et Generatione Hominis,* by Rueffs, which in 1637 was anonymously translated into English under the title of *The Expert Midwife,* was available for her instruction. This latter work shows well the strength of the feeling that then prevailed against the dissemination of knowledge in these matters. I quote from the preface as follows: "Some say it is unfit that such matters as these should be published in a vulgar tongue for young heads to pry into; true—but the danger being great and manifold, whether is it better that millions should perish for want of help and knowledge, or that such means, which though lawful in themselves yet may by some be abused, should be had and used? But young and raw heads, idle serving men, profane fiddlers, scoffers, jesters, rogues, avaunt—pack hence. I neither meant it to you, neither is it fit for you." It is interesting to note as a sample of the knowledge imparted by a study of the above-mentioned books that, in the former volume, twins are pictured in utero as arm and arm.

In the year 1653, however, the midwife had her first chance to gain information of a truly scientific character, since in that year the works of Harvey were translated into English, and Willoughby published his *Country Midwives' Opusculum,* while in 1671 Dr. William Sermon published *The Ladies' Companion; or, The English Midwife.* These books were of a very different character from the ones previously mentioned and marked a distinct advance in knowledge. Not to be outdone by mere man, an English midwife, in 1671, published a volume called *The Midwives' Book; or, The Whole Art of Midwifery Discovered; directing Child-bearing Women how to Behave Themselves.*

The first definite attempt to limit the abuses of the midwife in England (the other European nations were far in advance of England in this matter) is met with in the Seventeenth Century, as the strictures of Bishop Bonner before referred to, and the interrogations in the Province of Canterbury, emphasizing the duty of diligence upon the part of parsons and curates in the teaching of the midwives the proper method for the performance of Christian baptism, can hardly be accepted as an attempt at real obstetric control. It is interesting to note, however, that Andrew Boorde, in his *Breviary of Health,* in writing of the miseries resulting from an

"unexpert midwife," says that "There should be a certain manner of presenting a candidate for license to the Bishop, with regard to her character, and that this having been established, then the Bishop with the consent of a doctor of physic ought to examine her and to instruct her in that thynge that she is ignorant and thus proved and admitted is a laudable thynge." This, in the opinion of Aveling, is the first English expression that it is necessary to give instruction to midwives and a guarantee of their skill to the public. It is to be remembered that up to the middle of the Sixteenth Century it was considered entirely out of the question for a male physician to be present at a delivery unless it was one presenting marked difficulty. Indeed, the records show that Dr. Veit, of Hamburg, was burned to death in the year 1552 because he was present at a delivery disguised as a woman. It took a long time for this antagonism to men in obstetrics to die out. It may surprise you to know that as late as 1852, Charles D. Meigs, then professor of obstetrics at Jefferson Medical College in this city, in his introduction to his edition of Velpeau's *Midwifery*, gravely states, in supporting the propriety of male obstetricians, that the first woman must have been assisted in labor by a man, since Eve could have had no other assistance than that of Adam.

After the renaissance of medicine in the Sixteenth Century the medical and to some extent the lay public became anxious over the incompetence of the midwife. De la Touche refers to the "cursed and perverse ignorance" of those in France, and I particularly ask your remembrance that as early as 1646 Peter Chamberlain petitioned James I "that some order may be settled by the state for the instruction and civil government of midwives," while in 1646 his son Peter published the *Voice in Rhama; or, The Crie of Women and Children echoed forth in the Compassions of Peter Chamberlain,* in which book the author repeats the plea of his father for state control of midwives and inveighs bitterly against "the uncontrolled female arbiters of life and death," as he calls them. He evidently knew whereof he spoke, as he himself is authority for the statement that "the burthen of all the midwives in and about London lay only on my shoulders." William Harvey

also complained of the ignorance and haste of midwives, saying that "the younger more giddy and officious midwives who mightily bestir themselves and provoke the expulsive faculty do weary out the poor women and bring them in danger of their lives."

In 1687, Elizabeth Cellier, that most militant female, addressed a petition to James II, asking that control be established over the midwives of London and that some plan be prepared for the betterment of their education. At this period began the friction between the midwife and the medical profession. Until within a short time there had been but little choice between them on grounds of knowledge, and in all probability the greater element of safety for the patient was on the side of the midwife; but the invention of the obstetric forceps at once made a definite line of demarcation between the physician and the midwife and was the entering wedge in the decline of the latter. The medical profession, however, for years subsequently was by no means a unit against the midwife. Many doctors inveighed against the "instrumentarians," as the users of the forceps were called, as fiercely as did the midwives, and also were just as definite as they on the impropriety of the attendance of a man in cases of childbirth, at least in such cases as were normal, and they claimed that the very great majority were of that character, and that many cases were rendered complicated by the untimely intervention of the enthusiastic instrumentarian. The literature of this period is extremely interesting. A spade was called a spade with the most definite freedom. Elizabeth Cellier appears again in this connection; she never missed a chance of an altercation and upon this occasion addressed a doctor who had criticised her plans for midwife control in the following words: "I hope, doctor, that these considerations will deter any of you from pretending to teach us midwifery, which ought to be kept a secret among women as much as possible."

In the Seventeenth Century the employment of the physician became much more common, but the midwife still was a person of very great importance, as is shown by the petition sent to Parliament, September 22, 1646, during the civil wars of the period, entitled, "The Midwives Just Complaint and divers other well

effected gentlewomen both in city and country shewing to the whole Christian World the Just Cause of their Longsufferings in these Distracted times and their great fear of the continuance of it." In this remarkable document these midwives petitioned that the wars might be brought to an end, for the reason that the said wars "stopped childbirth and deprived them of a living," and that, in their own words, "whereas we were formerly respected and well paid in our parishes for our great skill and midnight industry (but) now our art doth fail us and little gettings have we in this age, barren of all natural joys and only fruitful in bloody calamities. We desire, therefore, for the better propagation of our own benefit and the general good of all women; wives may no longer spare their husbands to be devoured by the sword."

Much more could be said concerning the history of the midwife, particularly of the midwife of Continental Europe, but time forbids. I trust that at least you may be convinced that her history is interesting. Here in America we have allowed things concerning her to drift along, year after year, without much regard for consequences, as is our settled custom, until conditions have become intolerable. With a disregard for the safety of the citizen, which is so colossal that it is almost sublime, we have refused to recognize the menace presented by the midwife until at length we have been forced to take cognizance of the havoc she has wrought. We are years behind the nations of Europe in this regard, since they, while realizing the absolute necessity of the midwife, also realize her tremendous potentialities for evil and so have controlled her activities more or less successfully.

When, in 1913, the Bureau of Medical Education and Licensure of the State of Pennsylvania decided that, acting under the authority vested in them by the laws of the State, they would undertake the control of the midwife, they were immediately faced with the problem as to how this control was to be exercised: In other words, whether they would attempt the complete abrogation of these women, or whether they would educate and police them, with the idea that they are still an indispensable instrument in the handling of the problem of childbirth in civilized nations. The

former plan, namely, their abrogation, has been abundantly proved impossible by the experience of the civilized world, at least for the present; but that you may understand the reasons which governed the Bureau in its decision, I shall consider briefly why it is concluded that the midwife is in this progressive and enlightened Twentieth Century still to be considered as essential to the delivery of the poor.

It seems almost incredible that any one, not a confirmed idealist, cognizant of conditions as they exist, will fail to realize without further argument that the most vital and compelling reason for considering the midwife as a necessity today is that, without her aid, it would be impossible to care for the cases of childbirth in any large city or other locality in which a large portion of the population is composed of poor people. It is perfectly true that some of the critics of the course pursued by the Bureau hold this statement to be rank heresy. It is also true that certain communities believe that they do not need the midwife, and that if she were done away with their charitable institutions and physicians and nurses would be able to care for all of these women; but I can confidently assert that those holding such views are self-deceived.

Let us suppose, in refutation of this theory, that some miraculous legislation could be passed (in itself a miracle) which would be effectual in obliterating the midwife from the city of Philadelphia. Note the result which would certainly follow. For the first week or two the hospitals and private physicians of this city might be able to meet the demands, but after that time there would be no possibility of caring for the cases demanding attention. At the present moment there is no hospital maternity in this city which cannot be filled to the doors if it so desires, and if all maternities were run to capacity from one week's end to the next throughout the year, only allowing, moreover, twelve days per bed per patient, there would still be in this town alone five thousand women uncared for each year. Of course, one may predicate the employment of physicians by charitable or state agency, if one wishes to exercise the imagination, but can any sane person actually hope for the development of any such plan?

One of my friends, a physician greatly interested in all schemes for human betterment, sets up as his ultimate aim the giving of prenatal care to all pregnant women, the sending of a physician and trained nurse to each case of confinement, and the oversight of both mother and child after delivery for a period of several months. Now, granted that the enormous cost of such a plan were forthcoming, where are the necessary doctors and nurses to be obtained? Moreover, our problem is not that of a single ward or community even, but that which we have in mind is the ultimate betterment of conditions throughout the whole state and nation. All of us in this work are very anxious to improve the conditions surrounding childbirth among the poor for national as well as humanitarian reasons, and we most emphatically resent the charge that we hold a brief for the midwife. On the contrary, we assert, without hesitation, that she *is* an anachronism and a menace under the conditions at present operative, and that as soon as any better practicable scheme (I wish to emphasize the word practicable) is evolved, that we will be the first to applaud her retirement to the oblivion which is her due; but as yet, with the knowledge of the problem confronting us, which can only come from experience, we believe that we shall, within any given time, more nearly approach the ideal by the employment of supervised midwives than will the advocates of the various futile imaginings so far put forward as a substitute for her.

Upon the ground of practicability, therefore, the Bureau of Medical Education decided to attempt to control the midwife, and a plan now to be described was put into operation in this city and, in a slightly modified form, in Pittsburgh. The outstanding and unique features of this plan are, (1), the insistence upon a report from the midwife to the inspector who has her in charge, within forty-eight hours after the completion of a delivery, announcing upon a card (furnished by the state) the facts concerning said delivery, together with the address of the patient and the name of the midwife; and, (2), the inspection of each mother and baby within the first few days after delivery, by the inspector, a medical graduate with special training in obstetrics. We have

in the county of Philadelphia four inspectors—three being women, graduates of the Woman's Medical College of Pennsylvania; and one a man, a graduate of the University of Pennsylvania—and I desire here to state that the success of the plan which we have put into operation has depended, to a very large extent, upon the enthusiastic support which has been accorded by the present and former inspectors of the Bureau, namely, Drs. Roberts, Orecchia, Reis, Ostrow, Blitzstein and Hawthorne.

Every woman delivered in the county of Philadelphia by a registered midwife is seen within eight days after the labor, if the case has been and remains a normal one, or at any earlier date at which any abnormality makes itself manifest. The inspector makes a report to me of each case, and the data thus obtained form the bases of my quarterly report to the Bureau of Medical Education. The accountability of the midwife in this matter of reporting promptly to her inspector as to the condition of both of her patients, is most strongly insisted upon and was one of the hardest things to accomplish at first. She must not only report all deliveries within forty-eight hours of their accomplishment, but if any abnormality, such as infection of the eyes of the baby or any maternal complication, supervenes at a later date, she must at once communicate again with her inspector, in order that the latter may be kept informed as to the progress of all the cases and may if necessary at once institute proper treatment. Failure upon the midwife's part to observe this regulation results in her attendance upon the bimonthly disciplinary meeting of the inspectors, As a rule, this is sufficient punishment.

The two requirements just enumerated, namely, the report of the birth to the inspector by the midwife at the time of birth and the visit of the inspector within the first week of the baby's life, are unique in the history of attempted midwife control, having never been put into operation elsewhere. In all other localities, here and abroad, where control has been established, the authorities have been satisfied with the inspection of the midwife and allow her to do her work without exercising the oversight of the individual case. These two requirements form the foundation for our work;

we consider them essential and believe that without them we could not hope to achieve the results for which we are striving and to which we believe that we have attained in some small degree at least.

Among our other regulations are the following: If any abnormality occur during labor, such as undue prolongation or abnormal difficulty from whatever cause, the midwife is compelled to call in a physician, who takes charge of the case. If the patient be too poor to pay a physician's fee the midwife is compelled to notify her inspector, who then goes in the character of a consultant. It is to be noted, however, that this can only be done in the relatively few cases whose poverty precludes the employment of an independent physician. This limitation is imposed upon our inspectors very much against their will, but for good and sufficient reasons, in that the state does not desire to either pauperize the patient or to interfere with the work of the private physician. If any case arises of so serious a nature that hospital care is demanded, they are usually sent to the nearest hospital which will admit them, and we follow them until the case is complete.

We attempt to instruct our midwives by a series of elementary lectures given by the inspectors at intervals throughout the winter months. These lectures have been given in English and German and Italian and Yiddish. Twice during the year all midwives report to us for an inspection of their equipment, and we have been able to so greatly improve this during the past years that at present we feel quite well satisfied. The best outfits now in use by these women will compare favorably with those in the possession of the majority of general practitioners of medicine, and truth compels me to say that I have many times been called in consultation by physicians whose obstetric armamentarium was less extensive and well cared for. The less-well-equipped women are vastly improved over their former condition. They are all compelled to have certain essentials and to keep them in good condition. We have, however, always made some distinction between the busy, successful midwife doing her thirty deliveries a month and her less-active sister delivering but half a dozen women a year. They must come

up to a certain definite minimum, and this having been attained, we have tried not to unnecessarily increase the financial burden of the older, less-active women.

At the beginning of our work we found conditions to be chaotic. There had been, of course, no control of midwives previously; for, while it is true that the municipal authorities had attempted to do what they could, there had been no funds available for the purpose and no machinery to carry out any oversight. To be a success, the control of the midwife must be a state matter at least. Sometimes, in my dreams, I visualize what federal control could mean in relation to this question.

We found on investigation, at the commencement of our work, that there was no trustworthy list of midwives operating in this city; so we sent out our notices to all women whose names appeared on the list at the City Hall as having reported births to the Bureau of Vital Statistics within a period of several years past. In our notification we informed the women that the Bureau of Medical Education was now in charge, and that it would be necessary for every woman desiring to practice midwifery to have a license from the Bureau, and that to get this it was necessary to register and pay a fee of ten dollars. The vast majority of these notices were returned, as the women could not be found; but we collected and registered over two hundred within a few weeks. Of course, we were lenient in our requirements for registration at this time. If we had not been we would have been unable to register more than 1 per cent of the applicants. In other words, it was realized by the Bureau that it would be wrong to deprive these women of their livelihood because they could not satisfy a test suddenly proposed to them without any warning by the authorities of the State, especially as the said authority had not previously questioned their right to practice. As a final and most cogent reason for this leniency in the initial requirements, was the knowledge that if we did bar such a large proportion from the exercise of what they consider as their profession, the result would be that we would simply convert them into clandestine midwives whom it would be almost impossible to regulate or control in any way. It is to be distinctly

understood, however, that we were definite as to the improvement which must be shown by them if they wished to hold their license in the future, as the sole aim of the Bureau of Medical Education is the safety and the welfare of the patient and all regulations are made with that end in view.

It is a matter for congratulation that, originally, the midwife's license was made renewable yearly, since this fact gave us a better hold on the midwives during the early formative period of our work. Very recently, it has been decided in the courts that the license once granted is a permanent possession, the judge in his decision holding that only reasons valid in a court of law can justify its revocation. While this would have been unfortunate in the first years of our work, we have now progressed far enough in disciplinary training to get along very well without this power. My personal feeling is that the decision of the court is a perfectly just one; but at the beginning we found it an immense advantage to hold this power of revocation, as will be understood by any one who has attempted to teach the ignorant a due regard for law and order.

No one who has not had the experience can realize the difficulties met with in the formative stages of this work. These so-called midwives were of various nationalities, speaking various languages and even subvariant dialects of the same language, and, in this respect alone, their control presented far greater difficulties than those met with in European countries in dealing with the same problem. With the exception of a very few women who were graduates of various foreign schools, they were all densely ignorant, not only of any real obstetric knowledge, but also in matters of the most elemental personal hygiene. The few fundamental facts in obstetrics which they did know, they had gained along with a mass of spurious knowledge by tradition, than which there is nothing harder to eradicate, especially among the ignorant. Moreover, the vast majority of these women came from countries in which oppression has been the heritage of the lower classes for generations, and therefore, as is always to be expected, their truthfulness was not particularly noticeable. Finally, do not think

for a moment that these women of ours were desirous of coercion and anxious to learn—far from it. They were in most instances perfectly satisfied with their condition and, moreover, were in no mind to confess their need of teaching or to admit that their work could be improved. In fact, as I have often thought in dealing with them, they played entirely true to the form of their remote ancestors who edited *The Midwives' Just Complaint.*

Gradually, during the past seven years, the requirements for licensure as a midwife have been increased by the Bureau of Medical Education, until at the present time, and for some two years past, every applicant for a license must be able to speak, read and write English, and also, except under extraordinary conditions, must present a diploma of graduation from a school of midwifery, either here or abroad, recognized by the Bureau. In this country there are but two schools so recognized, namely, the one at Bellevue Hospital in New York City, and the one which very recently has been established at the Maternity Hospital of Philadelphia. Those applying to us from the former school have been but two in number, as Bellevue will only accept women who intend to practice in New York. The school here has been in operation only for the past few months, so that there has been no output of graduates as yet. Its course is of a year's duration, and its establishment is a matter of great congratulation from our standpoint, as it places us in a position which is tenable in respect to those who apply for license. For the past couple of years, we have been forced to tell applicants that we could not accept them unless they took training, and also that there was no place on the eastern seaboard where they could get it. Now, however, our position is unassailable; we have no control over the admissions to this school, but we can refer women to its management, and if they can produce satisfactory evidence of an ordinary English education and certification of moral character they will have the chance to obtain satisfactory training as midwives in the wards of that hospital. We are all deeply interested in this project, as we feel that if we can place women with good technical training in this field we shall be able to do away with much that does not please us in the work at present.

Some of the opponents of the midwife who have taken the trouble to really examine the question, and so have realized the necessity of the non-medical graduate being employed in this work, have expressed themselves as being in favor of utilizing the trained nurse to meet the demand. We are all in hearty accord if the scheme were practicable, but it hardly seems necessary to deny its feasability, at least to members of the medical profession, since the demand for trained nurses is so great that no woman with her qualifications needs to undertake the much more onerous task of the midwife, with its irregularity of hours, exposure and real hardship.

We are firmly convinced, as the result of the experience of the last few years, that, given a woman of good average intelligence, it is possible to train her within six months to conduct normal labor in a satisfactory manner and to recognize abnormalities in the course of labor in time to summon expert help; but I desire to state with the utmost emphasis, that we do not believe that any person of the type of even the best-trained midwife should ever be allowed to engage in the practice of her profession without the close oversight of properly constituted medical authority; with this oversight the midwife can aid the solution of many problems of real social service; without this, she is and always will be a menace to the patients entrusted to her care.

I here crave your indulgence to repeat what I have before stated, namely, that we—and by this I mean the Bureau of Medical Education and also those of us who are its representatives in this particular work—hold no brief for the midwife. I again most emphatically state that if a better plan than ours can be evolved, by the use of other agencies, to meet the actual conditions as we know them, we shall be most happy to see the midwife cease her activities finally and forever; but that until some real method is developed which will meet the actual demands we are compelled, for the good of humanity, to pin our faith to the plan of supervised midwives.

We feel that so far as the mere delivery of these patients is concerned we are well equipped in Philadelphia county for the work at present. We are by no means satisfied. When we reach that

pleasant frame of mind our places can with advantage be filled by others. But we do feel that a marked improvement is in evidence already, and that a still greater betterment is in store for the future. If we could "put across" the importance of our work as we see it, and thus obtain from the state of Pennsylvania a sufficient sum of money for the employment of social service workers as a follow-up agency during the first few weeks after the confinement, and for the establishment of educational propaganda among the patients looking to the development of prenatal care, we would be able to show statistics within a few years which would astonish the civilized world. In support of this last statement, I invite your attention to a few figures which I shall now offer and which I think will give you a chance to form your own conclusions as to whether the work in which we are engaged is worth the doing or not.

During the past seven years, in Philadelphia, there have been delivered by registered midwives under our control 52,749 women, and of these all except 1056 have been inspected within eight days after the birth; 1037 of these 1056 unvisited deliveries occurred in 1914, the first year of our work, at a time when the midwives were so poorly trained that our difficulties in inspection were very great. There have been but 19 parturients unvisited in the past five years. We are, therefore, in a position to offer some statistics which may be interesting, based as they are upon this rather considerable series of cases (51,693 inspected cases) of childbirth, and we feel that the figures, as we shall give them, are reliable, since although we only make one visit if the inspection of the case at that time shows the woman and child to be in good condition, it is, on the contrary, the invariable rule to follow all cases in which either the condition of the baby or the mother fails to satisfy us, until recovery or death completes the case. I feel, therefore, that while there may be a slight inaccuracy in our figures as given, due to the non-inclusion of a small number in which death or disability may have supervened after the inspection had been made, that for practical purposes the statistics are worthy of credence. Please bear in mind that the patients whose delivery we supervise are for

the most part ignorant, and that they live often in rather primitive fashion, and that these two factors influence final results as well as does lack of training and intelligence on the midwives' part.

With these explanatory statements in mind, I will ask you to consider a few of the results of our work. There have been 62 maternal deaths from all causes in this series of 51,693 deliveries, and it has interested us greatly to analyze the cause of death with particular reference to the responsibility of the midwife. We have had 14 deaths from puerperal sepsis among the 51,693 deliveries, a rather small percentage mortality. While we feel that it is very possibly not just, we nevertheless charge these deaths entirely to the midwife. However, in two of these cases it is but fair to state that the delivery was conducted by unlicensed women who have ceased to function. We had 1 death occurring in a case of twin pregnancy, complicated with hydramnion, the cause of death being given as shock. Such a fatality is not unknown in the hands of the profession, but still we feel that it is only fair to hold the midwife responsible since intelligent medical supervision might have saved the patient. There have been 7 deaths from convulsions during or soon after labor, and here we absolve the midwife, as we feel that these deaths are due to the ignorance of the patient and to the unavoidable lack of prenatal care, and that society is to blame rather than the midwife. We have had 2 deaths from hemorrhage, due to what is called placenta previa, namely, a malposition of the afterbirth, always a serious condition and quite frequently fatal to both patients; but to disarm criticism, we also charge these two deaths against the midwife, as we also do the hemorrhagic death in the one fatal case of premature separation of the afterbirth and in both the fatal cases of bleeding after delivery which we have recorded in our list.

Before leaving this particular subject, it may be suggested that the time lost by the midwife in calling a physician as consultant would be better spent in having the patient transferred to a hospital. It would be ideal if we could issue orders to this effect—in other words, that all cases of hemorrhage or other grave complication must be sent to a hospital at once; but this is impossible to effect until governmental paternalism is even more in evidence

than at present. Even so, our statistics are not so much worse than those found in general practice, since we had altogether 34 cases of hemorrhage during labor and lost but 3, and 97 cases of hemorrhage after delivery, losing but 2.

We do not feel that the deaths from uremia, heart disease, pneumonia, embolism, phthisis, diphtheria, or those occurring in the terrible epidemic of influenza, in 1918, in which 21 of our patients died, can by any stretch of the verities be laid to the midwife, but must rather be ascribed to the severity of the pathological condition, plus the environment of the patient, over which the midwife has no more control than would the physician. It is to be distinctly borne in mind that in the vast majority of all of these fatalities, a physician was called on the appearance of the abnormality and was in charge until death occurred. Thus, our figures show that 1468 cases were delivered by doctors. Over these consultants we have no control—some are competent and do not need it, others do.

It goes without saying that in a series of deliveries as large as this all the ordinary varieties of dystocia (difficult labor) have been met with. There have been 361 cases of inertia, 125 shoulder presentations, 52 face, 265 breech, 212 occiput, 60 funic prolapse, 30 eclampsia, 178 disproportion of head to pelvis, 59 retained or adherent placenta, 14 ablatio placenta and 20 placenta previa. There have also been 96 cases of sapremia, 19 cases of phlebitis, 32 of sepsis and 99 of puerperal hemorrhage. But 34 women have been removed to hospital for delivery, though 77 mothers and 38 babies have been subsequently admitted to hospitals for treatment. In 1101 cases a physician has been summoned because of the condition of the patient after delivery had been accomplished. These 51,693 women have been delivered of 52,033 children, there having been 333 cases of twins, 2 cases of triplets and 1 quadruplet birth.

The number of children dying from all causes in the first week was 1306. It is to be remembered that the same restrictions are operative relative to the exactures of this figure as in the case of the maternal mortality. An analysis of these deaths occurring among the infants shows that 103 may be classed as due to deformities incompatible with life, such as spina bifida, anencephalus, hydrocephalus, bowel atresia, monsters, etc. In addition, there

have been 82 cases classified as toxemias and infections, such as pneumonia, melena, enteritis, etc.

There were 99 deaths due to "injury at birth," under which term are included injuries from forceps and versions—all, of course, performed by physicians—and also from breech deliveries, a certain number of which were also conducted by physicians called in consultation by midwives. In other words, some of these babies died as a result of bad judgment or lack of skill on the part of the consultant.

There were 325 stillbirths reported. It is unfortunate that in the very large majority of this group we have no way of determining the cause of the death. Undoubtedly, syphilis played a considerable part; but any attempt to determine its prevalence as a factor has been impossible, for obvious reasons, and therefore no attempt has been made to estimate its frequency in any phase of our work.

In view of the recent enthusiasm for the routine performance of version at the beginning of the second stage of labor which has been prevalent in certain quarters, and which is possibly a revival of Dr. Slop's theories as set forth in *Tristrim Shandy*, it is interesting and very instructive to note that, while the chief advocate of that method reports 12 convulsive deaths in 1400 consecutive deliveries in his own hands, we have but 13 convulsive deaths to report in our whole series of 51,693 deliveries conducted by unskilled persons.

There have been 399 deaths due to the premature occurrence of the delivery. A certain rather small proportion of these could have been avoided had good surroundings and proper care been available, but in by far the large proportion of these cases the fetus was not viable, and the premature delivery must be ascribed to the hard work done by these women throughout pregnancy, together with the influence of the unrepaired damage of previous labors. Of course, syphilis also plays a marked causative role here, but, as has been said, we have no means of making the examinations needful for the establishment of its frequency.

There were 67 deaths of babies which have been ascribed to prolapse of the cord or abnormalities in its development. Certain of these cases could undoubtedly have been saved had the delivery

taken place in a well-appointed hospital; but it seems very questionable whether the most expert accoucheur would have been able materially to alter the mortality rate in this group, if compelled to work without assistance in the homes of these patients.

Of the 7 cases of death of the child from antepartum maternal bleeding it is to be remembered that this condition, whether due to placenta previa or placental separation, always gives a high fetal mortality even under ideal conditions.

There were 49 deaths not diagnosed as to causation, and of these nothing can be said.

There were 4 cases due to prolongation of labor and 55 cases of death from asphyxia neonatorum, and in a goodly number of these cases skilful attention might have saved the child's life; but it must again be noted that in many of these cases a physician actually made the delivery, so that it is fair to charge the medical profession with at least a portion of the mortality.

We find in our list 24 deaths from various causes, such as inanition, atelectasis, heat exhaustion, suffocation, etc., and 61 due to influenza at the time of the epidemic of 1918. The last class only need be referred to. All who were resident in Philadelphia during that nightmare have a vivid remembrance of its horror, and I feel it only just to offer here a tribute to the work of the midwives during those terrible days. Of these 61 babies, 22 were premature and 27 were stillborn. There were 12 babies born alive at term who died of intoxication or pneumonia within a few hours or days of birth.

A phase of our work which has been of great interest, because of its vital importance, is the care of the eyes of the newborn baby. To many outside of the profession whose experience is limited to the well-cared-for children of their own circle, the prevalence and tragedy of preventable eye disease among newborn infants is unknown.

There are two varieties of so-called "sore eyes" occurring among newborn babies, one due simply to the neglect of ordinary care and cleanliness, while the other is a very serious condition due to an infection of the child's eye with different varieties of microörganisms. This latter variety, in the vast majority of cases, results

from the presence of gonorrheal infection in the birth tract of the mother, is therefore called gonorrheal ophthalmia, and may readily result in blindness if not promptly and efficiently handled.

It is a well-established fact that a very large percentage of those blind from birth owe their condition to gonorrheal ophthalmia. A conservative estimate based upon the records of several institutions for the blind is that 20 per cent of their inmates are there because of gonorrheal ophthalmia at birth. Now, if this disease was unpreventable and incurable from its inception, the condition of affairs would be deplorable enough; but what adjective is adequate in the light of the universal experience that gonorrheal infection of the eyes of the child is to a considerable degree preventable, and that when it does occur in spite of attempted prevention it is curable in the vast majority of cases without impairment of vision? We believe that the work of the Bureau of Medical Education and Licensure among the midwives has been amply justified, if only by our results in this special field. Before the Bureau undertook the work there was little if any care exercised by the midwife as to the condition of the child's eyes, and no control whatsoever by higher authority, and during our early administration we found that probably the most frequent cause of offense upon the midwife's part was lack of attention to the eyes of the newborn. Each week we had a number of cases reported in which the eyes were found to be sore, simply from lack of ordinary cleanliness. In 1914, our first year, we had 324 cases of simple sore eyes reported, but this fell in 176 in 1915, to 110 in 1916, to 9 in 1917, to 8 in 1918, to 6 in 1919, and rose to 29 in 1920. The rapid primary fall is, we believe, an index of the increased care which we have compelled the midwives to exercise in this regard, while the slight increase in the past year over the previous two years is due to the increased use of the silver instillations at the time of birth, done to prevent the development of gonorrheal ophthalmia. If silver solution is carelessly instilled into the eyes, a chemical irritation results which, however, is not of serious import. The use of the prophylactic silver was began in 1916 under the orders of the Bureau of Medical Education and Licensure, and we used it at first with considerable trepidation, as because of the generally gross ignorance of our women

we feared that more harm than good might result. Such has not been the case, however, probably due in large degree to the fact that we do not allow the use of the solution from a stock bottle, but that the midwives are compelled to use the ampules furnished by the Board of Health of the city, each of which contains only enough solution of suitable percentage for one case. So much for the simple non-gonorrheal sore eyes, due simply to lack of care.

Of the incidence of true gonorrheal infection and the amount of its resulting blindness in midwives' hands, before the Bureau took charge of the work, we are unable to speak with authority, as there are naturally no statistics upon which to base our conclusions. Our records show 19 cases in 1914; 15 cases in 1915; 10 cases in 1916; 21 cases in 1917; 17 cases in 1918; 24 cases in 1919; 24 cases in 1920; total 130. In the year 1916, and again in 1919, we have had 1 case in which partial loss of sight resulted from this disease, due to corneal opacity. In both of these cases the parents of the child refused the treatment, and, as we have no police authority to remove the child or to treat it without consent of the parents, we were helpless in the matter. It gives us much satisfaction, however, to say that since 1915 we have not lost an eye completely and that the only cases not entirely cured are the two above mentioned. Of this fact we are sure, as we follow every case of true ophthalmia until the cure is assured. The saving in mere money to the state of Pennsylvania in this one item alone is at least equal to the total cost of the work in Philadelphia county.

We have not found a decrease in the incidence of ophthalmia since the instillation of silver at the time of birth has been made obligatory, and, in addition, we have found that until the women had used it for nearly two years there was the frequent incidence of chemical ophthalmia as a result. For the last three years, however, the chemical ophthalmia has been negligible. The reason that the use of silver in the eyes at birth has not acted as well with us, as a preventative, as is usual in hospital practice, is the same as the cause of the increased proportion of chemical irritation after its use, namely, the difficulty of training the midwives to instill the solution properly. The fact, however, remains that even under the adverse conditions we have, by the insistence upon the personal

inspection of these cases, been able to prevent the loss of an eye during the past four years. (When the above was written it was true, but very recently we have had a case of ophthalmia of gonorrheal origin which has resulted in the complete loss of both of the child's eyes. It is a sad commentary upon our civilization that such an occurrence can take place, but it certainly shows the necessity of midwife control. In this particular instance the report of the birth was duly made to the inspector by the midwife, and the baby was found to be normal at the time of the routine visit, which was made on the second day. As we learned later, the eyes became sore the day following, and this fact was not reported by the midwife until too late to save the eyes. This child, if it lives, will of necessity be placed in a blind asylum. Now, if there were no supervision, this midwife would go on in her ignorance and carelessness without hindrance. She has no sense of guilt in this matter, as was shown at the preliminary investigation which we conducted; but in the eyes of the Bureau such negligence, when proved, is considerable inexcusable, and her license has already been revoked. If she attempts to continue her work she will be arrested.)

This question of the midwife, which I have brought to your attention in this very inadequate manner, is one of vast national importance. Whether or not my argument—backed as it has been by statistical data necessarily imperfect—has convinced you, I am sure at least that you will all admit that there is an insistent responsibility resting upon the American people which should no longer be shirked. I refer to it as a national responsibility advisedly, since, while I have spoken but of one county in one single state, our own, the conditions surrounding childbirth among the poor elsewhere in this country are just as bad, with few exceptions, as they were here before our Bureau of Medical Education and Licensure undertook this work. In the preparation of this paper it seemed well to get a view of conditions throughout the United States, and, therefore, a questionnaire was sent to the health officer of every state in the Union. Most of the answers were interesting and many were illuminating. A very few were of such a nature as to suggest that it would probably be well to begin by establish-

ing control over certain state boards of health before attempting espionage of the midwife.

In order that you may have an idea of the conditions prevalent in other parts of this country, certain conclusions based on this questionnaire will be given. If it is borne in mind that the facts as stated refer not to high-grade cattle, but to women and children here in America, these statistics, though dry at first sight, will be interesting. It is necessary to bear in mind that there is no possibility that the statistics are scientifically accurate. The very nature of the inquiry precludes this; but at least the conditions are not better than the statements made.

As far as can be judged from the replies received, New York (33 per cent delivered by midwives in New York City), New Jersey, Connecticut, and Pennsylvania are the only states at present attempting any real control of the midwife. It is true that a license to practice is necessary in twenty states, and if this requirement is accepted at its face value it would give one interested in this work a feeling of great satisfaction; but there is need of but slight examination of the facts to show how farcical this so-called licensing is in the great majority of instances. For example, the state of Missouri reports that 10 per cent of her population is delivered by the midwife, Wisconsin puts it at 20 per cent, Rhode Island at 12 per cent, and Illinois, while unable to hazard a definite percentage, says it is rather high, and yet all these states frankly admit that the law regarding the midwife is not enforceable. The state of Alabama replies that 60 per cent of her population is born in the care of her 1500 midwives, and that she has control of them, but that the said control is in the hands of the various county officers. The same is true of the 3000 midwives of Mississippi and the 5000 midwives of North Carolina, who deliver 80 per cent of the colored and 20 per cent of the white in her population.

Now, as I have previously stated, I am convinced that nothing less than state control is really efficient in meeting the midwife situation, and, as an example of what I mean, I would call attention to the state of Ohio, where this same method of control by the county officers is operative. Ohio says that she has 350 midwives, and I rather fancy that the efficiency of the control exercised may

be well gauged by the fact that she replies that there is no way of estimating the amount of work done by the midwife, but that it is "negligible except in cities with foreign population and in the mining districts." In other words, there is apparently no knowledge at all as to actual conditions and certainly no great concern felt for the fate of the foreign population in her cities or mining districts; at the least, a short-sighted policy, as events in this country seem to be shaping to demonstrate in the near future.

Kentucky has 2500 midwives, who are untrained and who deliver 20 per cent of her population, and she is insistent that they are a necessity. Virginia has 7000, untrained, who deliver 40 per cent of the general population throughout the state and 29 per cent of those born in the city of Richmond, and she too considers her an essential. California has 101 well-trained women, and states that the number delivered by them is very small except among the Italian, Polish, Japanese and possibly the Chinese races. She also considers her an essential. Maryland has 1906 midwives, poorly trained, who deliver 66 per cent of her women, and she considers that the midwife is essential except in cities. Connecticut has 220, who are well trained, and who deliver 13 per cent of the cases of childbirth, and she feels that they are necessary. Minnesota has 161 midwives, and reports them as well trained but does not know the percentage of deliveries managed by them; does not think that they are a necessity; while Wyoming, with 11 untrained midwives, who deliver but 1 per cent of her women, does not consider them necessary. Leaving out of our computation states such as Wyoming and Minnesota, where the problem is evidently not a pressing one, California where only the Italian, Polish, Japanese and possibly Chinese immigrants are injured by the midwife, we are confessedly doubtful whether any of the states mentioned in the list, as requiring licenses for midwives, are to be regarded as in any way exercising real control in any degree whatsoever. So much for the states which require licensure of the midwife.

If the conditions are not satisfactory in this group, the aspect of affairs can be imagined in those states where not even the subterfuge of the license is insisted upon. These states are Michigan,

Oklahoma, New Mexico, Montana, Idaho, Tennessee, West Virginia, Nebraska, South Carolina, Georgia, New Hampshire, Nevada, South Dakota, Maine and Iowa. Of these states just mentioned, nothing can be said as to the actual conditions in Michigan, Oklahoma, Idaho, Nebraska, New Hampshire, South Dakota, Maine, Iowa or Nevada, as these states confess to have no laws relative to the midwife and no knowledge at all on the question. In passing, however, it may be germane to state that this same attitude of ignorance was maintained until very recently by the state of Massachusetts; but it is gratifying to learn that she has seen a light, as she now answers that, while they do not legally recognize the midwife, they have found in a recent limited survey of a section of the state comprising nine towns that there were 117 midwives in active work; and in reply to the question as to the necessity of midwives, she answers that, while it is impossible to give a definite statement at present, "it seems significant that they have been unable to get rid of the midwife by process of law." Massachusetts now admits that she possesses all varieties of midwives from the standpoint of training. I own to a suspicion that a similar survey in many of the states which either do not recognize the midwife or deny her existence would show a similar condition. The percentage ratio between the number delivered by midwives and physicians, of course, will differ widely in different sections of the country.

On the other hand, New Mexico is asking that she be given control through legislative action, which is certainly to be desired, as she has 40 per cent of the births in midwives' hands; while Montana seems to be alive to the need for control, since, although but a small number are delivered by midwives, she nevertheless believes them to be necessary. Tennessee also hopes that she may obtain control at an early date. West Virginia has no law regarding midwives and no definite knowledge of their activities, but if the 7000 untrained women delivering 40 per cent of the population in Virginia be remembered, it seems not farfetched to suppose that the conditions in West Virginia are approximately the same. South Carolina reports 500 registered and "a legion" unregistered, who deliver 80 per cent of her colored and 20 per cent of her white

population, and she makes an insistent plea as to the necessity for midwives as far as she is concerned, stating that portions of the state are entirely beyond the reach of the physician. Georgia has 5000 women working as midwives, who deliver 22 per cent of her children.

I am of the opinion that you will agree with me, that it may be considered as a fact that no real control is attempted in any of the states except the five mentioned some time ago, namely, New Jersey, New York, Connecticut and Pennsylvania, and even in these states the conditions, while vastly better than in the remainder, are far from ideal.

Am I wrong in accentuating our national responsibility in this matter? Is it a little thing that the vast multitude of women delivered by unskilled attendants throughout this land should be subjected to the unnecessary hours of agony, the injuries and the infections, with death or invalidism as a result, which are inseparable from the work of the untrained and unsupervised midwife? Is it a small matter that preventable blindness is in no way prevented or that a multitude of children die at birth who could easily be saved?

It is my honest opinion, the result of the experience of the past seven years in this work, that the conditions as portrayed in this paper are the result of ignorance of the facts as far as the general public is concerned, and of the remedy upon the part of the authorities. If it were possible to visualize conditions as they are known to many of us, for the instruction of legislatures and the general public of the various states, it would result in a demand for betterment which would not be denied.

Do you realize what delivery in unskilled hands means? If the case be a normal one in essentials, and if it be not interfered with by ignorant attendants, the result may be perfectly satisfactory; but ill-advised interference easily converts the normal into the abnormal, while among the many cases pathological from the start which fall to the tender mercies of these women there are many appalling tragedies occurring daily. There is nothing fanciful about this statement. It is simply cold fact. Do you realize that here in America, in this Twentieth Century, many

thousands of women are delivered each year in identically the same careless and ignorant fashion as in medieval times, save that the terrible mulating operations upon the child are not nearly so frequent? Finally, do you know that a large proportion of the foreign element would have received better and more skilful treatment in their own lands than we give them? These are also facts.

In the opening paragraphs of my paper I said that I believed I had something of a constructive nature to offer for the betterment of conditions existing today. In brief, it is the following: Taking it for granted that you will admit that the possibility of the delivery of all women in their homes by trained obstetricians is unthinkable, and that hospital accommodations are likewise not to be attained for more than a small fraction of all maternity cases, I submit that if the individual states, or the Federal Government, would undertake the training and the real supervision of midwives, a betterment could be brought about in the next ten years which is hardly to be imagined at the present time. The first step is the control and education of the midwife; the second, the constant supervision of her work by competent medical authority. While various modifications to meet individual conditions would be undoubtedly necessary, such as subsidization of the midwife by the state for the care of the very poor, they would simply be minor in character since the principle remains the same, and the cost of a complete system, wherever needed, throughout this whole country would be but the smallest fraction of the cost of any of the other plans proposed, such as hospitalization, with the added advantage of feasibility. It is true that this would be an innovation perhaps without precedent, but allow me to close by quoting the plea of Peter Chamberlain, the younger, written in the year of 1646, asking the state for the identical thing which I am advocating tonight. He says: "Shall want of precedent be here objected? Because there was never any order for instructing and governing midwives, therefore must there never be? Because multitudes have perished, therefore must they still perish? Because our forefathers have provided no remedy, nor knew any, therefore must we provide none, though we know it?"

ANNUAL REPORT OF THE LIBRARY COMMITTEE FOR 1921

Mr. President: In accordance with the ordinances and By-Laws of the College, I herewith submit the following report of the Library Committee for the year 1921:

Total number of volumes in the Library, including the bound volumes and 17,760 unbound "Reports" and "Transactions"	130,220
Number of unbound "Theses" and "Dissertations" .	12,568
Number of unbound pamphlets	127,956

Included in the above are 3,828 volumes known as "Reserves," consisting of second copies of some of the more important periodical publications; also 3,016 volumes more or less incomplete.

The duplicates which are not included in the above total, number 8,714 at this date.

The following table shows the number of volumes in the various divisions of the Library:

	Bound.	Incomplete and unbound.	Total.
General Library . . .	91,862	2,972	94,834
Lewis Library	13,717	44	13,761
On permanent deposit:			
S. D. Gross Library . .	3,645	3	3,648
Library of the Obstetrical Society of Philadelphia	217	0	217
			112,460

Received during the year from all sources, 4,854 volumes, 19,186 pamphlets and 10,768 numbers of various periodicals.

Divided as follows:

	Volumes.	Pamphlets.	Journals.
General Library	3,919	19,086	10,768
Lewis Library	17		
S. D. Gross Library . . .	42		
By purchase, General Account	484		
In exchange	392	100	
	4,854	19,186	10,768

	Volumes.
Accessions (including 43 volumes of "Reserves"): 2,989.	
General Library	2,930
Lewis Library	17
S. D. Gross Library	42
	2,989

Total increase in the number of volumes for the year: 2,989.

Photographs received in response to requests sent out during the past year and voluntary gifts:

Fellows, 6. For the War Album (Fellows of the College), 5. Other than Fellows, 63.

Total number of portraits listed, 10,046.

The individual "donors" for the year ending November 1, 1921, number 447; this represents 919 distinct presentations. Each gift is duly acknowledged and properly recorded.

The following list shows individual gifts of more than twenty-five volumes, and the number of volumes presented by the various publishing houses:

	Volumes.
Dr. J. Solis Cohen	1265
Dr. John Aulde	348
Dr. William M. Welch	245
Dr. Charles W. Dulles	164
Dr. John L. Atlee	160
Mr. Frank Zentmayer	135
Dr. S. Solis Cohen	61
Dr. Edward P. Davis	57
Dr. R. S. Hooker	53
Dr. W. W. Keen	37
Dr. John B. Roberts	35
Miss E. B. Kirkbride	27
Dr. James C. Wilson	27
Dr. Hobart A. Hare	26

From the publishing houses of:

	Volumes.
P. Blakiston's Son & Co.	32
F. A. Davis Company	13
Lea & Febiger	23
J. B. Lippincott Co.	14
W. B. Saunders Co.	50
William Wood & Co.	6

The Library is indebted for large gifts of pamphlets and unbound periodicals to the following donors:

Dr. A. P. C. Ashhurst
Dr. John Aulde
Messrs. P. Blakiston's Son & Co.
Dr. Burton Chance
Dr. J. Solis Cohen
Dr. S. Solis Cohen
Dr. Edward P. Davis
Dr. Warren B. Davis
Dr. W. A. N. Dorland
Dr. Augustus A. Eshner
Dr. Henry M. Fisher
Dr. J. P. C. Griffith
Dr. S. McC. Hamill
Dr. Alfred Hand
Dr. Hobart A. Hare
Dr. Addinell Hewson
Dr. Charles F. Judson
Dr. W. W. Keen
Dr. John A. Kolmer
Dr. H. R. M. Landis
Dr. Morris J. Lewis
Messrs. J. B. Lippincott Co.
Dr. George M. Marshall
Dr. Edward Martin
Dr. Charles K. Mills
Dr. Elliston J. Morris
Dr. Charles C. Norris
Dr. Francis R. Packard
Philadelphia Bureau of Health
Phipps Institute
Dr. A. N. Richards
Dr. David Riesman
Dr. John B. Roberts
Dr. George G. Ross
Messrs. W. B. Saunders Company
Dr. A. C. Sautter
Dr. G. E. de Schweinitz
Dr. William J. Taylor
U. S. Department of the Interior
U. S. Public Health Service
Dr. William M. Welch
Dr. Henry R. Wharton
Messrs. S. S. White Dental Co.
Dr. Frank Woodbury
Dr. M. W. Zimmerman

1029 new publications were added to the Library during the past year; 36 of these works were written or edited by Fellows of the College.

15 volumes were presented by the following authors or editors:

Dr. Frederick W. E. Burnham
Dr. Edward P. Davis
Mr. K. G. Falk
Dr. Jefferson Demetrius Gibson
Dr. Alfred Gordon
Dr. Hobart A. Hare
Dr. Hobart A. Hare (Editor)
Mr. C. M. Higgins
Mr. Frederick L. Hoffman
Mr. Douglas C. McMurtrie
Dr. Herman Otto Mosenthal
Dr. Charles C. Norris
Dr. Francis R. Packard
Dr. Robert Dawson Rudolf

6 volumes were sent by the publishers at the request of the following authors or editors:

Dr. Brooke M. Anspach
Dr. Albert C. Buckley
Dr. Lawrence F. Flick
Dr. George H. Heald
Dr. Henry Leffmann
Mr. William W. Merritt

Summary of the "Funds":

	Volumes purchased.	Cost.
Henrietta Rush Fales Baker Fund	82	$422.12
Luther S. Bent Fund	18	17.54
William T. Carter Fund	88	488.69
Girardus Clarkson Fund	4	11.61
Francis X. Dercum Fund	106	301.86
Louis A. Duhring Fund	25	138.16
John D. Griscom Fund	141	434.23
William F. Jenks Fund	121	408.23
Oliver A. Judson Fund	8	15.90
William V. and John M. Keating Fund	37	73.15
William W. Keen Fund	39	145.12
Library Endowment Fund	145	1,408.78
Horace Magee Memorial Fund	145	768.25
J. Ewing Mears Fund	71	319.42
Charles K. Mills Fund	3	1.42
Weir Mitchell Fund	27	113.63
John H. Musser Fund	16	31.08
Elizabeth K. Newcomet Fund	27	57.48
William F. Norris Fund	46	221.17
Charles A. Oliver Fund	16	38.07
Philadelphia Medical Society Fund	2	11.21
Lewis Rodman Fund	64	579.84
Douglas Stockton Warren Fund	58	174.88
John F. Weightman Fund	5	6.85
Caspar Wistar Fund	78	431.49
	1,372	$6,620.18

Special Accounts:

Fund for completing files of journals . . .	66	$332.35
Fund for rare and valuable books	65	4,525.19
S. D. Gross Library Account	26	204.40
	157	$5,061.94

George B. Wood Fund—Library supplies, stationery, etc. Expended $349.05.

Morris Longstreth Library Fund—On account of salaries. Expended $981.50.

Catalogue Endowment Fund—On account of salaries. Expended $42.50.

Louis A. Duhring Fund—General purposes of the Library. Expended $14,800.

Books bound 1,545.

Use of the Library: Visitors, 5,067; Fellows, 2,181; Total, 7,248.

The Library has been kept open two evenings each week and on the six minor legal holidays, for the same hours and period of time, as during the past year:

Evenings.	Visitors.	Fellows.	Total.
77	523	180	703
Legal holidays	81	25	106

The above figures are included in the total given for the year.

	1921.	1920.	Decrease.
Number of books consulted in the Library	16,333	19,021	2,688

The number of books reported as "consulted in the Library" includes only those supplied on demand. Readers have access to the bound volumes of periodicals and works of reference kept on the shelves in the Reading Room, and the Fellows have access

to the Book-Stacks. There are, therefore, a great many volumes consulted of which no accurate record can be kept.

	1921.	1920.	Decrease.
Number of books taken out .	3,419	3,683	264

Use of Study-Rooms: Average number of rooms in use throughout the year: 6. Greatest number in use at one time: 7. Daily average of the number of volumes in use in these rooms: 159.

Cataloguing: Works, 1,369; Volumes, 1,748; Cards written, 6,872; Printed cards revised, 1,689.

All books added to the shelves during the past year and 148 of the more important pamphlets have been catalogued and shelf-listed; and all bound volumes, including periodicals, transactions and reports have been accessioned.

Revision of the Catalogue: 3,461 cards have been revised rewritten and filed.

6,564 unbound pamphlets and reprints have been subject-headed and arranged alphabetically by subject, and by author under the subject. The binding of pamphlets by subject is still held in abeyance on account of the excessive charges occasioned by labor conditions.

We have listed November 1, 1921, 1,207 current periodical publications, including "Transactions" and "Reports," obtained through the following sources:

	American.	Foreign.
Endowment Funds	64	296
By purchase from General Account . . .	44	318
In exchange	61	91
Editors	102	17
Publishers	15	2
In addition, current numbers of periodicals have been received, at stated intervals, through the courtesy of the editor of the Therapeutic Gazette.	26	24
	312	748
Reports, not included in the above . .	134	13
	446	761

The actual number of current periodicals received during the year, including new subscriptions (7 American and 25 Foreign), total 906. This is an increase of 138 over the previous year and made up, to a large extent, by German publications. We are still carrying our lists intact and changes are made only when official notification is received from our Agents or from the Journals themselves. This plan it seems advisable to continue for some time to come.

The following is a list of the foreign schools of medicine with which we exchanged publications prior to the war; for the present, as in the case of periodicals, it seems advisable to keep this list intact:

University of Amsterdam	University of Königsberg
" Basel	" Lausanne
" Berlin	" Leiden
" Bern	" Leipzig
" Bonn	" Liège
" Breslau	" Lund
" Erlangen	" Marburg
" Geneva	" Rostock
" Giessen	" Strassburg
" Göttingen	" Upsala
" Greifswald	" Utrecht
" Halle	" Würzburg
" Heidelberg	" Zurich
" Kiel	

Faculty of Medicine of Bruxelles
" " Paris
" " Toulouse
" " Yucatan

We have heard, during the past year, from Basel, Bern, Breslau, Giessen, Göttingen, Halle, Kiel, Königsberg, Leipzig, Lund, Marburg, Rostock, Toulouse and Würzburg. 2,584 dissertations and 40 theses have been added to our collection.

We have received in cash from the sale of duplicates for the current year ending November 1, 1921: $355.60.

During the past year we have distributed books and journals, on exchange account, to the following:

Boston Medical Library
Kansas City Medical Library Club
Library of the Medical and Chirurgical Faculty of the State of Maryland, Baltimore
Library of the Surgeon-General's Office, Washington, D. C.
Mayo Clinic Library, Rochester, Minn.
Medical Library Association, Baltimore
Medical Society of the County of Kings, Brooklyn

And have received exchanges from:

Boston Medical Library
L'Institute Sérotherapique del'Etat Danois, Copenhagen
Kansas City Medical Library Club
Library of the Medical and Chirurgical Faculty of the State of Maryland, Baltimore
Mayo Clinic Library, Rochester, Minn.
Medical Library Association, Baltimore
Medical Society of the County of Kings, Brooklyn
New York Public Library, New York City

With the aid received from exchanges and purchases made with funds appropriated for the purpose by the Library Committee, we have, since November 1, 1920, completed the files of the following journals:

Anales de la Asociàcion Larrey, Mexico City
Bulletins et Mémoires de la Société Française d'Opthalmologie, Paris
Revue Obstétricale et Gynécologique, Paris

Amount of fines collected from November 1, 1920, to November 1, 1921: $96.15.

The following is a list of the rare medical books and works of special interest received during the past year:

Incunabula

(Total number of incunabula at this date, 305 Titles, 287 Volumes)

Aegidius Columna. Commentarii in octo libros Physicorum Aristotelis. Venetiis, Hieronymus de Durantis, 1493. [Hain 128.]
Fund for Rare Books.

Albertus Magnus. Opus Alberti Magni de mirabilibus mundi. [Bononiae, Balthasar Azzoguidus, circa 1473.]
Not in Hain.
Fund for Rare Books.

Alexander Aphrodisiensis. Enarrationes de anima ex Aristotelis institutione latine per Hieronymum donatum. Brescia, Bernardinus Misinta, 1495. [Hain-Copinger 656.]
Fund for Rare Books.

Apollinaris Cremonensis. Expositio in primum posteriorum Aristotelis.*** Venetiis, Bonetus Locatellus for Octavianus Scotus, 1493. [Hain 1284.]
*Contains also—Blanchellus Faventinus, Mengus. Questiones.**** 1492.
Fund for Rare Books.

Avicenna. De animalibus per Michael Scotu de arabico in latinu translatus. [Circa 1500.] [Hain 2220.]
Perfectly preserved copy in original boards.
Fund for Rare Books.

Beroaldus, Philippus. Annotationes centum. Brixiae, Bernardinus Misinta, 1496. [Hain 2946.]
Fund for Rare Books.

Carvaial [Bernardinus]. Cardinalis S. Crucis. Oratio in die circumcisionis Domini. [Rome, Plannck, 1484.] [Hain 4546.]
Fund for Rare Books.

Collenucius, Pandulpus. [Pliniana defensio adversus Nicolai Leoniceni accusationem.] Ferrariae, Andreas Bellfortis Gallus. [circa 1493.] [Hain-Copinger 5483.]
First edition.
Fund for Rare Books.

Dioscorides Anazarbeus, Pedacius. [De materia medica.] Venetiis, Aldus Manutius, 1499. [Hain 6257.]

Greek text.

Fund for Rare Books.

Faber, Jacobus. [In Aristotelis octo Physicos libros Paraphrasis.] Parisiis, [Johannes Highmann, Germanus] 1492. [Hain-Copinger 6939.]

Rare first edition.

Fund for Rare Books.

de Ferrariis, Theophilus. Propositiones ex omnibus Aristotelis libris philosophicis*** collectae. Venetiis, Johannes et Gregorius de Gregoriis, 1493. [Hain 6997.]

Presented by J. Solis Cohen, M.D.

Gerson, Johannes. Conclusiones de diversis materiis moralibus.*** [Coloniae, Ulrich Zell, 1470.] [Hain 7639.]

Fund for Rare Books.

Gerson, Johannes. Tractatus de simplificatione stabiliconne seu mundificatione cordis.*** Cologne, Ulrich Zell, circa 1472. [Hain 7681.]

Very rare first edition

Fund for Rare Books.

Guainerius, Antonius. Opera medica. Pavia, Antonius Carcanus, 1488. [Hain 8089.]

Fund for Rare Books.

de Nursia, Benedictus. [Libellus de conservatione sanitatis secundum ordinem alphabeti distinctus.] [Romae, Stephanus Plannck, circa 1490.] [Copinger 4445.]

Fund for Rare Books.

de Nursia, Benedictus. Libellus de conservatione sanitatis. Romae, Stephanus Plannck, 1493. [Hain 11922.]

Fund for Rare Books.

Petrarca, Francesco. [De remediis utriusque fortunae.] Cremonae, Bernardinus de Misintis de Papia et Caesar Parmensis, 1492. [Hain-Copinger 12793.]

Fund for Rare Books.

Petrus Hispanus [Pope John XXI.] [Practica medicinae, quae thesaurus pauperum nuncupatur.] Florentiae, Bartholomaeus de Libris, circa 1490.] [Hain 8914.] [Reichling. V. p. 144.]

ff. 93–94 *repr. in facsimile.*

Fund for Rare Books.

[Rolevinck, Werner.] [Formula vivendi Canonicorum.] [Coloniae, Arnoldus Therhoernen, circa 1480.] [Hain-Copinger 7253.]

Rare edition.

Fund for Rare Books.

Works of Special Interest

Agricola, Georgius. Libri quinque de mensuris et ponderibus; in quibus pleraque a Budaeo et Portio parum animadversa diligenter excutiuntur. Venetiis, de Nicolinis de Sabia, 1535.

Fund for Rare Books.

Alhazen. Opticae thesaurus libri septum nunc primum editi. Basilae, per Episcopios, 1572.

Fund for Rare Books.

Anstey, Chr. Ad Edvardum Jenner, M.D. Carmen alcaicum. Londini, Cadell, 1803.

[*Contains also, his—Ode to Jenner.*** 1804. Translation by John Ring.*]

Caspar Wistar Fund.

Arnoldus de Villa Nova. Treasure of pore men. London, Myddylton, 1544.

The first edition was that of Bankes (1526–1528). *Others were Redman,* 1539, *and Petyt,* 1541.

Horace Magee Memorial Fund.

Avicenna. Liber canonis Avicenne revisus et ab omni errore méndaque purgatus summaque cum diligentia impressus. Venetiis, per Paganium de Paganinis, 1507.

Fund for Rare Books.

Bacon, Roger. Opus majus. Londini, Bowyer, 1733.

Very rare large paper copy of editio princeps.

Fund for Rare Books.

Bacon, Roger. The Philosopher's Stone; or Grand Elixir, Discover'd by Friar Bacon, and Now Publish'd as a Counter Part ot the Degradation of Gold by an Anti-Elixir. With a Few Notes, by no Adept. London, Woodfall, 1739.

*The translator states in his preface that "The following piece is a translation from the original Latin of Roger Bacon's Speculum Alchemiae,"*** but does not say upon what edition or text his version is based. Newly discovered work—Voynich.*

Fund for Rare Books.

Barbarus, Hermolaus. In Dioscorides corollarioru[m] libri quinque.*** Coloniae, Soter, 1530.

Fund for Rare Books.

Bartolettus, Fabritius. Methodus in dysponeam seu de respirationibus libri iv.*** Bononiae, Dozzae, 1633.

Fund for Rare Books.

Basso, Sebastian. Philosophiae naturalis adversus Aristotelem libri XII.*** Geneva, Petrus de la Roviere, 1621.

Very rare. First edition published in Paris in the same year.

Fund for Rare Books.

Bertrand, Nicolaus. Nova philosophandi ratio de urinis.*** Rhedonis, Durand, 1630.

Fund for Rare Books.

Bourdelot, Pierre Micon. Recherches et observations sur les viperes répondant à une lettre qu'il a receüe de Francesco Redi. Paris, Barbin, 1671.

Fund for Rare Books.

Boyle, Robert. Experimenta et observationes physicae; wherein are briefly treated of several subjects relating to natural philosophy.*** London, Taylor, 1691.

Horace Magee Memorial Fund.

Bratti, Giovanni. Discorso della vecchia et nuova medicina, nel quale si ragiona delle cose ritrouate à nostri secoli, e particolarmente dell'oro artificiale. Venetia, Meietti, 1592.

Fund for Rare Books.

Browne, Joseph. An essay towards the forming a true idea of fundamentals in physick, upon the mechanism and structure of blood.*** London, Marshall, 1719.

Fund for Rare Books.

Brudo Lusitanus. De ratione victus in singulis febribus secundum Hippocratem in genere et sigillatim libri III. Venetiis, Rubeus, 1559.

Fund for Rare Books.

Brunner, Balthasar. Consilia medica; summo studio collecta et revisa à Laurentio Hofmano. Halle-Saxonum, Faber, 1617.

First edition of this posthumous work.

Fund for Rare Books.

Bucius, Dominicus. Quaesita medicinalia IIII. Lugduni, Honorati, 1555.

Fund for Rare Books.

Caius, Bernardinus. Disputatio de vesicantium usu. Venetiis, Deuchinus, 1603.

Fund for Rare Books.

Cardanus, Hieronymus. In septem aphorismorum Hippocratis particulas commentaria.*** Basileae, Petri, 1564.

First edition.

Henrietta Rush Fales Baker Fund.

Castner [Johan]. Wie man sich in Pestilentzischen sterbsleuffen vor der vergifftung bewaren möge und dargegen den vergifften mit artzney wider helffen ein klare unterrichtung sampt andern naturlichen nottürfften menschliche gesundtheyt zuerhalten. Nuremberg, Johann Petreius, 1542.

Extremely rare first edition of a work which has escaped the notice of bibliographers.

Horace Magee Memorial Fund.

Cirvelo, Pedro [Sanchez]. Hexameron theological sobre el regimiento medicinal contra la pestilencia. Alcala Henares, de Brocar, 1519.

Extremely rare first edition, from a celebrated press famous for its beautiful types. Brocar was the printer of the first Polyglot Bible.

William T. Carter Fund.

Claudinus, Julius Caesar. Responsionum et consultationum medicinalium tomus unicus.*** Hanoviae, Wechel, 1628.

Rare edition.

Henrietta Rush Fales Baker Fund.

Colbatch, Sir John. The generous physician, or medicine made easy; containing plain and exact descriptions of the causes, symptoms, and method proper for the cure of several distempers incident to the human body.*** London, Roberts [1700].

John D. Griscom Fund.

Commelin, Joannes et Commelin, C. Horti medici Amstelodamensis rariorum*** à Frederico Ruyschio et Francisco Kiggelario. Amstelaedami, Blaeu, 1697–1701.

A magnificent library copy of Commelin's most important book. The impression of the plates is very fine. Text, Latin and Dutch.

Fund for Rare Books.

Crollius, Oswald. Bazilica chymica, et praxis chymiatrice; or, Royal and practical chemistry.*** 3 Vols. in 1. London, Starkey, 1670.

Very rare first edition.

Lewis Rodman Fund.

Descartes, Renatus. Epistolae, partim ab auctore Latino sermone conscriptae, partim ex Gallico translate.*** Londini, Dunmore, 1668.

Very rare first edition printed in England.

Henrietta Rush Fales Baker Fund.

Descartes, Renatus. Principia philosophia. Ultima ed. Amstelodami, Elzevir, 1664.

Horace Magee Memorial Fund.

Dionis [Pierre]. Dissertation sur la mort subite et sur la catalepsie.*** 2 Ed. Paris, d'Houry, 1718.

Fund for Rare Books.

Ettmüller, Michael. Nouvelle chirurgie médicale et raisonnée.*** Amsterdam, Aubie, 1691.

Fund for Rare Books.

Faber, Petrus Joh. Hercules piochymicus.*** Tolosae Tectosagum Bosc, 1634.

Extremely rare first edition.

Fund for Rare Books.

Fabricius Hildanus, Gulielmus. His experiments in chyrurgerie: concerning combustions or burnings, made with gun powder, iron shot, hot water, lightning.*** London, Alsop, 1642.

Fund for Rare Books.

Facio, Silvestro. Difesa interno lo sputo di sangue. Firenze, Sermatelli, 1596.

Fund for Rare Books.

Falcinelli, Bernardino. Instituzione alla cirugia. Firenze, Onodri, 1649.

Fund for Rare Books.

Faust, Victor. Aristotelis mechanica*** ac latinitate donata. [Parisiis] Badii, 1517.

Fund for Rare Books.

Ficinus Florentius, Marsilius. Opuscula. Marsilii Ficini Florenti de sole et lumine, libri duo. Venetiis, de Vitalibus, 1503.

Fund for Rare Books.

Finella, Filippo. De metroposcopia, seu methoposcopia naturali. 3 Vols. in 1. Antverpiae, Ex officina Plantiuiana, apud Balthassarem Morenum, 1648.

Fund for Rare Books.

Finella, Filippo. Delle vertu occulte delle vipere per le 28 mansioni delli segni del zodiaco.*** Napoli, Longo & Beltrano, 1634.

Very rare first edition enumerating 140 *diseases, Greek and Arabic derivations of the names.*

John D. Griscom Fund.

del Garbo, Dinus. Sup[er] q[ua]rta fen primi [Avciennae].*** Venetiis, Lucas Antonius Giunta, 1522.

Fund for Rare Books.

Gardini, Francesco Giuseppe. De effectis electricitatis in homine. Genuae, Scionici, 1780.

Extremely rare work.

John D. Griscom Fund.

Glauber, Joannes Rudolphus. Furni novi philosophici, sive descriptio artis destillatoriae novae.*** 6 Vols. in 1. Amsterdam, Jansson, 1658.

Rare second edition of an important work, describing many new chemical processes which are illustrated by wood-cuts.

Fund for Rare Books.

Glisson, Francis et al. De rachitide, sive morbo puerili, quo vulgo the rickets dicitur, tractatus.*** 2 Ed. Londini, Roycroft, 1660.

Original and classic account of infantile rickets. Garrison.

Fund for Rare Books.

[de Goes, Emmanuel et de Couto, S.] Commentators. Commentariorum Collegii Conimbricensis, Societatis Iesu, in octo libros physicorum Aristotelis Stagirite.*** 2 Vols. in 1. Cologne, Zetzner, 1599.

Rare edition of celebrated commentaries to Aristotle's physics.

John D. Griscom Fund.

Hasius [Joannes]. Prefatio laudatoria in artem chiromanticam. Augsburg, Erfford, 1519.

Very rare first edition.

Caspar Wistar Fund.

Highmore, Gulielmus Reynolds. De frigoris in corpus humanum potestate. Edinburgi, Balfour, 1776.

A most elaborate and unusual example of Scotch binding, in fine state. His armorial book-plate, dated 1779, *inserted.*

John D. Griscom Fund.

Hooke, Robert. Micrographia; or, Some physiological descriptions of minute bodies made by magnifying glasses, with observations and inquiries thereupon. London, Martyn, 1665.

Fund for Rare Books.

Jorden, Edward. Discourse of natural bathes and mineral waters.*** To which is added, an appendix concerning Bathe.*** 3 Ed. London, Salmon, 1669.

Horace Magee Memorial Fund.

Keill, James. Essays on several parts of the animal oeconomy. 2 Ed. London, Strahan, 1717.

Presented by Edward B. Krumbhaar, M.D.

Langham, William. Garden of Health; containing the sundry rare and hidden vertues and properties of all kind of simples and plants. 2 Ed. London, Harper, 1633.

Rare edition of an interesting work.

Caspar Wistar Fund.

Laurentius, Andreas. Discursus philosophicus et medicus de melancholia et catarrho*** a Joanne Theodore Schönlino*** ex Gallico libello Latio adscriptus. Augsburg, Aperger, 1620.

Very rare first edition.

John D. Griscom Fund.

Leclerc, Jean. Physica sive de rebus corporeis libri quinque.*** Londini, Swall, 1696.

Horace Magee Memorial Fund.

Le Febvre, Nicolaus. Compleat body of chemistry.*** Rendered into English by P. D. C. 2 Vols. in 1. London, Pulleyn, 1670.

Horace Magee Memorial Fund.

Liebaut, Jean. Quatre livre des secrets de medecine, et de la philosophie chemique, faicts françois. Roven, Behovrt, 1628.

Rare edition of a translation of the second part of Conrad Gesner's De secretis remediis liber, from the edition of 1556. *The translation was first published at Lyons in* 1573. *Other editions appeared at Rouen* 1594, 1643.***

Fund for Rare Books.

Lully, Raymund. De alchimia opuscula quae sequuntur. Apertorium. Item magica naturalis. Item de secretis naturae.*** Norimbergae, apud Petreius, 1546.

Extremely rare early edition.

Fund for Rare Books.

Maffei, Gio. Camillo. Scala naturale; overo fantasia dolcissima. Venice, Varisco [1573].

Extremely rare edition of a very interesting work on alchemy.

Fund for Rare Books.

Magni, Pietro Paolo. Discorso sopra il modo di fare i cauterij o rottorij a corpi humani.*** Roma, Bonfadino, 1588.

Very rare first edition.

John D. Griscom Fund.

Maier, Michael. Themis aurea; the laws of the fraternity of the Rosie Crosse.*** Whereto is annexed an epistle to the fraternity in Latine, from some here in England. London, Brooke, 1656.

Very rare first English edition of a work by a celebrated defender of the Rosicrucians.

William T. Carter Fund.

Manning, James. A new book, intitled, I am for you all, complexions castle; as well in the time of the pestilence, as other times, out of the which you may learne your complexion, your disease incident to the same and the remedies for the same. Cambridge, Legat, 1640.

Extremely rare first edition, the rarity of which is shown by the fact that no copy has been sold at English public auctions since 1887.

Fund for Rare Books.

Martinius, Henricus. Anatomica urinae Galeno-spagyrica, ex doctrina Hippocratis.*** Francofurti, Fickwirti, 1658.

*Contains also—Odonius, C. De urinarum.*** 1658.

Fund for Rare Books.

Martius, Galeotus. De doctrina promiscua.*** Florence, apud Laurentium Torrentium, 1548.

A suppressed work of great interest.

Fund for Rare Books.

Massa, Nicolas. Liber de peste contractus una cum observationibus e Diomede Amico et celeberrimo viro [Ricardo] Mead collectis. London, Mears, 1721.

Rare edition with commentaries by Mead.

Caspar Wistar Fund.

Massa, Nicolas. Liber introductorius anatomiae sive dissectionis corporis humani.*** Venetiis, Bindoni, 1536.

Extremely rare first edition.

Fund for Rare Books.

Massella, Bernhardt. Bericht von der Pest; oder, Kurtze Instruction, wie man sich in contagiosischen Suchten und absonderlich diss 1679 Jahrs himund wider grassierende Pest-Praeservative und Curative verhalten solle.*** Lintz, Mayr, 1679.

Extremely rare official anti-plague instructions, printed in a provincial Austrian town where only a few books were printed, all very rare.

Henrietta Rush Fales Baker Fund.

May, Edward. Most certaine and true relation of a strange monster or serpent found in the left ventricle of the heart of John Pennant, gentleman, of the age of 21 yeares. London, Miller, 1639.

William T. Carter Fund.

Meletius. De natura structuraque hominis opus.*** Nicolao Petreio Coreyraeo interpreter. Venetiis, Gryphius, 1552.

Contains also—Polemo Atheniensis. Philosophi naturae signorum interpretationis. Hippocrates. De hominis structura. Diocles Carystens. Ad Antigonum regem de tuenda valetudine epistola. Melampius. De nervis corporjs tractatus.

Fund for Rare Books.

Mercurialis, Hieronymus. Responsorum et consultationum medicinalium, nunc primum a Michaele Columbo collectus, et in lucem editus. 4 Vols. in 2. Venetiis, apud Jolitos, Senensem et Juntas, 1587–1604.

Fund for Rare Books.

Montanus, Joannes Baptista. Libri de excrementis, hoc est, faecibus et urinis; duo. Num medicamenta aequalia, an inaequalia sint, unus, Necnon de Gallico affectu unus. Iano Matthaeo Durastantio, medico physico sanctoiustano censore. Venetiis, Balth. Constantine, 1556.

Very rare edition of three important treatises.

Fund for Rare Books.

Montanus, Joannes Baptista. Opuscula, a Valentino Lublino Polono collecta. Venetiis, Constantius, 1556.

William F. Jenks Fund.

ap Morgan, Shinkin. The Welch doctor; or, The Welch-man turned physician, being a new way to cure all diseases in these times.*** [Cardiff] 1643.

Fund for Rare Books.

Mulcaster, Richard. Positions wherein those primitive circumstances be examined which are necessarie for the training up of children either for skill in their booke or health in their bodie.*** London, Vautrollier, 1581.

Extremely rare and important first edition. Written by the famous Elizabethan schoolmaster who is supposed to have been the inspiration of Holofernes in Love's Labour Lost, and one of whose early pupils is said to have been Edmund Spenser.

Presented by Henry Reed Hatfield, Esq.

Munierus, Joh. Alcidius. De venis tam lacteis thoracicis quam lymphaticis novissime repertis. Sylloge anatomica.*** Genvae, Guaschi, 1654.

Fund for Rare Books.

Naudé, G[abriel]. History of magic, by way of apology, for all the wise men who have unjustly been reputed magicians, from the Creation to the present age. Englished by J. Davies. London, Streater, 1657.

Extremely rare first edition of a famous work.

Fund for Rare Books.

Paracelsus [Bombastus ab Hohenheim] Aurelius Philippus Theophrastus. Kleine Handt-Bibel und Einfuhrung oder Lehr zum Ewigen Leben dess Herrn Jesu Christi; in welcher alle Schätz der Himmlischen Weissheit*** gegeben durch Johan Tholden. Lych, Ketzel, 1605.

Extremely rare first edition. Johann Tholde or Tholden, a 16th century chemist at Frankenhausen, und part owner of the salt works there. He edited some works of Basil Valentinus, and according to Liborius ab Indagine, was secretary to Rosicrucians.

Fund for Rare Books.

Paracelsus, Aurelius Philippus Theophrastus Bombastus ab Hohenheim. Of chymical transmutation, genealogy and generation of metals and minerals, also of the Urim and Thummim of the Jews, with an appendix, of the virtues and use of an excellent water by [Stephen] Trigge. Translated into English by R[obert] Turner. London, Rich, 1657.

Fund for Rare Books.

Paullini, Christianus Franciscus. Lycographia, seu de natura et usu lupi; libellus physico-historico-medicus.*** Francofvrti ad Moenvm, David, 1694.

Fund for Rare Books.

Pemel, Robert. Tractatus de simplicium medicamentorum facultatibus; a treatise of the nature and qualities of such simples as are most frequently used in medicines.*** London, Simmons, 1652.

Fund for Rare Books.

Person, David. Varieties; or, a Surveigh of rare and excellent matters, necessary and delectable for all sorts of persons.*** Digested into five bookes.*** London, Badger, 1635.

Very rare and only edition of an interesting work.

Fund for Rare Books.

Petruccius, Thomas. Spicilegium anatomicum de structura, et usu capsularum renalium. Romae, Tizzoni, 1675.

Fund for Rare Books.

Petrus Hispanus. Treasury of healthe, containing many profitable medicines gathered out of Hipocrates, Galen and Avicen. [London] Coplande [1538].

A very early English printed book; the type is similar to that used by Wynkyn de Worde and Pynson.

Fund for Rare Books.

Pharmacopoea Belgica; or, The Dutch dispensatory.*** Whereunto is added, the compleat herbalist.*** Rendered into English. London, Horn, 1659.

Fund for Rare Books.

Philalethes, Philo. Chrysopoiea; being a dissertation on the hermetical science. Wherein is proved by undeniable arguments the possibility of making gold by art.*** London, Roberts, 1745.

*Extremely rare; preface states that: "The treatise itself was originally wrote in the Spanish language by a Benedictine monk, the present Bishop of Oviedo.****

Fund for Rare Books.

Pierce, Robert. Bath memoirs; or, Observations in three and forty years practice, at the Bath, what cures have been there wrought (both by bathing and drinking these waters) by God's blessing. Bristol, Hammond, 1697.

Fund for Rare Books.

Pigray, Pierre. Chirurgia cumaliis, medicine partibus juncta. Parisis, Orry, 1669.

J. Ewing Mears Fund.

Plenck, Joseph James. De morbi de denti e delle genie. Venezia, Orlandelli, 1798.

Rare edition of an important work.

William T. Carter Fund.

Porta, Giovanni Battista. Phytognomonica octo libris contenta.*** Francofurti, Wechel, 1591.

*Contains also his—De humana physignomonia.**** 1593.

Fund for Rare Books.

Prynne, William. Healthes; sicknesse, or a compendious and brief discourse; proving, the drinking and pledging of healthes, to be sinfull, and utterly unlawfull unto Christians.*** London, 1628.
Fund for Rare Books.

Pyrophilus, F. A. Liquor alchahest; or, A discourse of that immortal dissolvent of Paracelsus and Helmont.*** London, T. R. and N. T. for W. Cademan, 1675.
Fund for Rare Books.

Robeck, Johannes. Exercitatio philosophica. Rintelii, Enax, 1836.
First edition of an interesting apology for suicide.
Horace Magee Memorial Fund.

Robinson, Nicholas. Treatise on the virtues and efficacy of a crust of bread, eat early in a morning fasting.*** London, Robinson, 1756.
Contains also his—5 *Ed.* 1767.
Fund for Rare Books.

Rorarius, Nicolaus. Contradictiones, dvbia, et paradoxa in libros Hippocratis, Celsi, Galeni, Aetii, Aeginetae, Avicennae. Cum eorundem conciliationibus. Venetijs, Bindonus, 1566.
Fund for Rare Books.

de Rossi, Gioseppe. Discorso sopra gli anni climatterici.*** Roma, Bericchia, 1585.
Fund for Rare Books.

Solingen, Cornelis. Alle de medicinale en chirurgical werken mitsgaders embryulcia vera.*** Amsterdam, Hoorn, 1698.
William F. Jenks Fund.

Spuntonus, Joannes Baptista. La metoposcopia; overo commensuratione della linee della fronte. 2 Ed. Venetiae, Deuchino, 1629.
Fund for Rare Books.
Extremely rare and curious work.

Stella, Benedetto. Il tabacco opera.*** Roma, Filippo Maria Mancini, 1669.
Rare first edition. Not quoted in the Surg. Gen. Libr. A copy in the Br. Mus.
William T. Carter Fund.

Stockar [Johann] of Ulm. Ein grundtlichs warhaftigs regiment wie man sich mit aller speyss getrank und früchten halten sol.*** Ausburg, Ulhart, 1538.

John D. Griscom Fund.

Stubbe, Henry. Lord Bacon's relation of the sweating-sickness examined. London, Brigs, 1671.

Fund for Rare Books.

Stubbe, Henry. Miraculous conformist; or, An account of severall marvailous cures performed by the stroaking of the hands of Valentine Greatarick; with a physicall discourse thereupon in a letter to the Honourable Robert Boyle.*** Oxford, Hall, 1666.

First edition.

Fund for Rare Books.

Tardinus, Joannes. Disquisitio physiologica de pilis. Turnoni, Linocer, 1609.

Extremely rare monograph on hair and diseases of the hair.

Henrietta Rush Fales Baker Fund.

Tryon, Thomas. The way to health, long life and happiness; or, A discourse of temperance.*** 2 Ed. London, Newman, 1691.

Caspar Wistar Fund.

Turner, Robert. Brittish Physician; or, The nature and vertues of English plants.*** London, Wood, 1664.

Fund for Rare Books.

Valles Covarrubianus, Franciscus. In libros Hippocratis de morbis popularibus commentaria, magnam vtriusq. Medicinae, theoricae inquam et practicae, partem continentia. J. P. Ayroldi nunc quàm prius excusa. Coloniae, Ciotti, 1588.

Fund for Rare Books.

[Vescovo, Michele]. Lecce con la sua provincia de Salentini preservata dalla peste negli anni 1656 e 1690.*** Lecce, Micheli, 1691.

Fund for Rare Books.

Vigier, Jean. La grande chirurgie des tumeurs. Lyon, Compagnon, 1670.

Fund for Rare Books.

Vigier, Jean. La grande chirurgie des ulceres.*** Lyon, Compagnon, 1774.

Fund for Rareks. Boo

Viridet, Jean. Tractatus novus medico-physicus de prima coctione praecipuéque de ventriculi fermento.*** Genevae, Chouët, 1691.

Fund for Rare Books.

[Vogtherr, Heinrich]. Eyn kunstreichs warhafftigs und wolgegrundtes urteil und secret buchlin des harns.*** Strassburg, Vogtherr, 1538.

Extremely rare first edition of a work which is attributed to the well known German artist, Heinrich Vogtherr.

Henrietta Rush Fales Baker Fund.

Wagstaffe, John. Question of witchcraft debated; or a discourse against their opinion that affirm witches, considered and enlarged. 2 Ed. London, Millington, 1671.

Rare and interesting work.

Fund for Rare Books.

Webster, John. Displaying of supposed witchcraft, wherein is affirmed that there are many sorts of deceivers and imposters and divers persons under a passive delusion of melancholy and fancy.*** London, F. M., 1677.

Horace Magee Memorial Fund.

Winckelmann, Joh. Just. Caesareologia, sive quartae monarchiae descriptio a Julio Caesare, Romanorum imperatore primo, ad imperium usque invictissimi imperatoris Leopoldi.*** Lipsiae, Tarnov, 1688.

Very rare interesting work.

Fund for Rare Books.

Worthy treatise of the eyes; containing the knowledge and cure of one hundred and thirteen diseases incident unto them.*** London, Kyngston, 1622.

Contains also, Of the nature and divers kinds of cancers or cankers. Wier [Joh.] Discourse of the scorby, translated out of Weyr's observations. Very rare and curious.

William F. Norris Fund.

Zahn, Godfried. Andr. Dissertatio de origine, progressu, et dignitate medicine.*** Vesaliae, Wesel, 1708.

William F. Norris Fund.

Manuscripts

Norris, George Washington. Early history of medicine in Philadelphia. [Philadelphia, 1886.]

Presented by his grandson, George William Norris, M.D.

Salernum, School of. [Regimen sanitatis Salernitanum.] Venetiis [circa 1495].

Not in Hain. Extremely rare.

Fund for Rare Books.

Other Interesting Additions

Member's Badge, Third International Congress of Surgeons, Bruxelles, 1911, presented by Dr. W. W. Keen.

A photograph of the Laboratory of the "16 Gen. Hosp. B. E. F.;" a photograph of the "Surgical Teams" of the U. S. Base Hospital 10—16 (Phila. U. S. A.) Gen. Hosp. B. E. F. presented by Dr. Edward B. Krumbhaar.

A holograph letter of John Hunter, dated December 11, 1791, addressed to Edward Jenner, presented by Dr. Morris J. Lewis, to whom it was given by Mrs. John K. Mitchell.

A curious hand-bill entitled "Directions for Treating Persons in the Small-pox," presented by Charles J. Sawyer, Ltd.

A holograph letter of Sir Astley Cooper, dated October 29, 1828; a card of admission to Dr. Desmarres' Clinic, dated March 3, 1851, presented by Dr. George E. de Schweinitz.

We have also received during the year a number of interesting and more or less valuable autograph letters.

This is the fifth anniversary of the use of a Photostat in the Library of the College and it seems appropriate that a more extended account of it should be given in this report.

Previous to the installation of the Photostat, November 1, 1916, the Library Committee had made itself acquainted with the many advantages to be derived from its use; not in any manner as a business proposition, but as a question of increased service to the

Library, to the Fellows of the College and to the profession in general.

The Photostat has a prism attached to the lens; prints directly upon sensitized paper, the copy being the same size and position as the original; this first copy, known in photography as a negative, is not reversed, and therefore answers the purpose, in a majority of cases, for literary work at a minimum expense. Where it is desired that the copy should appear in the same form as the original a print is taken from the negative which results in what is called a positive, a perfect reproduction of the original except, possibly, in the color of the paper. Enlargements, which are often desirable in copying illustrations, and reductions, when desired, can be made without difficulty. A very ingenious book-holder is connected with a movable carriage upon the front of the machine, which permits of copies being made of pages in bound books without injuring the binding.

While this is the first medical library to install a photostat the only publicity has been a paper on the subject presented to the Medical Library Association, June 4, 1917, by Mr. Charles Perry Fisher, the Librarian; a lecture given in the College building before the Pennsylvania Library Club, November 19, 1920, likewise by Mr. Fisher, and an announcement on each notice sent to the Fellows of the meetings of the College, during the past five years. A wider field would be given to its usefulness if the subject was taken up and noted from time to time in the medical periodicals. It covers, to a great extent, the question of inter-library loan service and more or less the so-called "community-service." With the aid of the Photostat accurate copies of articles from bound or unbound books and journals are furnished at a nominal sum, in many cases at less than the cost of expressage to and from the worker, and again the photostat copy becomes the property of the person to whom it is sent. Of great importance to the Library is the fact that the danger of loss or damage to the books in transportation is eliminated; also that the physicians of Philadelphia and vicinity, or physicians in the vicinity of any library using the Photostat, are not deprived of the use of books and journals.

It is to be hoped that the medical libraries of this country, or at least the larger medical libraries, will give the matter of the Photostat, as part of their equipment, greater consideration. This Library was the first medical library to use a typewriter in ataloguing; the subject was brought to the attention of the Medical Library Association in 1903, and years passed before, as at present, the typewriter became part of the equipment of every library. The Photostat is a more expensive proposition, and possibly a longer time will elapse before it will be included as a necessary adjunct of the modern library.

During the past year there have been furnished to Fellows of the College 651 prints; and to others than Fellows, on application, 382 prints. These outside applications include requests from Boston, Chicago, Los Angeles, New York, Philadelphia, Pittsburg, Washington, Great Britain, and Germany. Photostat copies of the material requested was promptly supplied and satisfaction was expressed in every instance.

The work for the Library has been continued according to the original instructions of the Committee; 7,110 large and small prints have been made; 27 volumes of incunabula completed, as well as various portraits and manuscript documents.

Up to the present time there have been made Photostat copies of 151 incunabula.

During the year there has been a slight increase in the number of new publications received: 89.

The following table is of interest, in a way, showing the variation in the number of new books received from 1915 on. The figures for 1921 cover pretty thoroughly all the important medical publications issued in the countries mentioned:

	1921.	1920.	1919.	1918.	1917.	1916.	1915
United States . .	312	274	357	506	456	425	283
Great Britain . .	275	270	164	154	121	161	100
France	123	44	152	96	144	15	8
Germany . . .	302	330	. . .	4	20	90	175
Other countries .	17	22	14	10	23	43	8
	1,029	940	687	780	764	734	574

There was an increase to the principal of the Library Endowment Funds during the past year of $98.43, but practically no additions. The total of the Library Endowment Funds at this date is $357,497.02.

An account of stock has been taken in connection with the shelf-list and all books found in order.

There has been an increase in the number of visitors to the Library over the preceding year of 71 and a decrease in the number of books reported as consulted in the Library of 2,688; also a decrease in the number of books taken out, of 264.

As has been said before the figures given in the annual reports, showing the variations in the use of the Library from year to year, are of interest, principally, as indicating the activities, and more especially the local activities, of the medical profession in literary work; but do not indicate the progress and usefulness of the Library. The value and success of the Medical Library is to be judged by the increase in its capabilities for satisfying the needs of the scientific investigator and the student of medical literature.

In regard to binding, conditions remain practically the same as last year; prices are excessive, and only the periodical publications and new books received from abroad have been bound. It seems advisable to wait until there is some betterment in labor conditions before extra binding is attempted.

Library Committee,
Francis X. Dercum, M.D.,
Chairman.

INDEX

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S